The
Geographical Journal.

No. 4. APRIL, 1905. VOL. XXV.

RESULTS OF THE NATIONAL ANTARCTIC EXPEDITION.—I. GEOGRAPHICAL.*

By Captain ROBERT F. SCOTT, C.V.O., R.N.

IN the following paper I propose to confine myself mainly to the purely geographical results of the Antarctic Expedition, in considering the distribution of land, water, and ice within the area allotted to us for exploration. I do so because a true estimate of these conditions will be arrived at, not so much by a close study of records as by a free discussion of observations and ideas, which, crude as they may be, can be advanced at once without prejudice. I avoid referring otherwise than in the most general terms to the results of the other scientific work carried out by our specialist investigators, partly because I realize my inability to cope with such a task in a satisfactory manner, partly because the main outline of much of the work has already been given by the officers concerned, but mainly because the time at my disposal is inadequate to do more than consider the subject which I have chosen. I believe that the matter which I propose to set before you is of general interest, and had I attempted further digressions, not only must it have been robbed of its interest, but too large a field would have been opened to the discussion which I hope may follow. I must assume, in all that I have to say, that the published reports of the history of the expedition are known.

Pack Ice.

The ice-conditions in the Ross sea have been observed in the course of five different summers. Although differences in date make it impossible to closely compare those seasons, one is led to believe that four

* Read at the Royal Geographical Society, February 27, 1905. The provisional map in vol. 24, p. 248, may be referred to; a finished map is in preparation, and it is hoped will be published in the *Journal* before the end of the year.

were very similar and constitute the normal condition, whilst one, the summer of 1902–3, was exceptional. The normal condition seems to be that the sea becomes completely frozen over in the winter, the movement of the ice-sheet leaving narrow spaces of open water only at its edge in such places as the northern face of the Great Barrier, and possibly in occasional rents, which are speedily refrozen. The emperor penguin undoubtedly takes advantage of the continual strip of open water that fringes the barrier.

The gales at Cape Crozier grow excessively violent towards the end of September and in October, and by this time the sun has taken some effect on the ice-sheet. The general break-up which results has been witnessed on two occasions by our sledge parties ; on one day they saw the sea completely covered with ice, and on the next looked forth on a clear sheet of open water. The ice thus freed drifts to the north, and forms that belt of pack through which ships must pass to reach the sea in the early summer. Drifting under the influence of wind, loose pieces of ice will always travel faster than the main pack, and consequently the southern edge of the band will generally be a hard and fast line, where loose pieces are crowding on the main pack, and the northern edge will be free, where loose pieces are tending to detach themselves from it.

Towards the end of December and the early part of January this belt extends from the Antarctic circle for about 200 miles to the south, and, as Captain Colbeck has said, is probably best attacked on the meridian of 178° to 180° E. To the westward of this the pack would be augmented by the coastal ice of Victoria Land, and to the eastward by conditions which are not well known, but on which the discovery of Scott island and the difficulties experienced by Ross seem to throw some light.

The ice probably leaves the Ross sea in large fields, and is broken by the ocean swell, which penetrates the pack for a very great distance; and this accounts for the fact that the floes increase in size as one approaches the southern edge, nowhere exceeding 1 or 2 miles in length. In this connection it is interesting to note the large fields, 4 or 5 miles across, which Captain Colbeck saw north of the Balleny islands in 1900.

The character of the ice frequently changes, giving the impression that a quantity of ice of a previous season is caught when the sea freezes over; but none of the ice met with is formidable—all is more or less rotten and decayed.

The exceptional ice-conditions of the summer of 1902–3 seem to have arisen from causes commencing at a very early date in the winter of 1902. What must be considered an abnormal succession of southerly gales again and again broke up the ice in McMurdo sound, and even late in the winter there was open water within a few miles of the *Discovery*. The continual formation of fresh sheets of ice must have tended to congestion, which the exceptionally fine-weather conditions of December and January failed to relieve, so that the greater part

CAPTAIN ROBERT FALCON SCOTT, C.V.O., R.N.,

COMMANDER OF THE NATIONAL ANTARCTIC EXPEDITION.

of the Ross sea remained filled with ice, and not only had the *Morning* great difficulty in getting to the south, but the sea was never sufficiently open to admit of the swell, on which we depended to break up the fast ice in McMurdo sound and free the *Discovery*.

In connection with the latter fact, it is of interest to note that, though the main pack drifts to the north early, there is an eddy in McMurdo sound in which a mass of ice is detained throughout December and January. At the end of January in 1902 and 1904 this mass was suddenly carried to the north, but it did not disappear until nearly a month later in 1903. When this occurred there was a noticeable change in the drift of the surface waters through the strait.

Continuing to drift northward, the main pack is dissipated by the beginning of February, and during this month a ship, by coming directly south on the 178th meridian, could reach the Great Barrier without encountering any pack ice. The sea-ice met with on the coast of Victoria Land is of a quite different character from that found in the main pack. It is very hard, very solid, comparatively free from snow, and, except where dust and grit have settled on the surface, very little decayed. Its uniform smoothness shows that there is very little pressure. In the bays and inlets we noticed that the floes had a great regularity of outline, and especially in Granite harbour we found that the ice-sheet had broken into almost perfect rectangular rectilinear figures. In all the coast ice there were large quantities of diatoms, which gave a yellowish-brown appearance to the underside of the floes. The pack ice met with in the vicinity of King Edward's Land was very heavy, but differed in character. Some floes were much hummocked, and were evidently more than one season old, whilst others were of comparatively recent growth. It appears probable that a large quantity of pack is detained amongst the numerous grounded bergs and ice islands in this region, where also the snowfall seems heavier than to the west.

The region south of the Balleny islands will probably always be found heavily packed. Our course from Robertson bay to the north, and then to the west past Sturge island, practically gives the eastern limits of this pack at the end of February, 1904, although Ross found, at the same season in 1841, that it did not lay beyond the 168th meridian.

Icebergs.

The main supply of icebergs in the Ross sea is from the Barrier and the eastern land. The glaciers on the coast-line of Victoria Land are in an extraordinary condition of stagnation, and nearly all the bergs met with along the coast have undoubtedly come from the east. From Cape Adare to Cape Crozier there are only two ice-flows capable of giving off a clean tabular berg of any dimensions. The rate at which various regions give off bergs can be to some extent gauged by the comparative newness of the exposed faces of the ice-cliffs.

Innumerable bergs are aground on the shoals off the eastern land, and some are very large. We saw one or two small ones in the act of calving from the high cliffs in that direction, but we did not see any being detached from the Great Barrier, and gathered from an examination of the edge that it must break away in very large pieces.

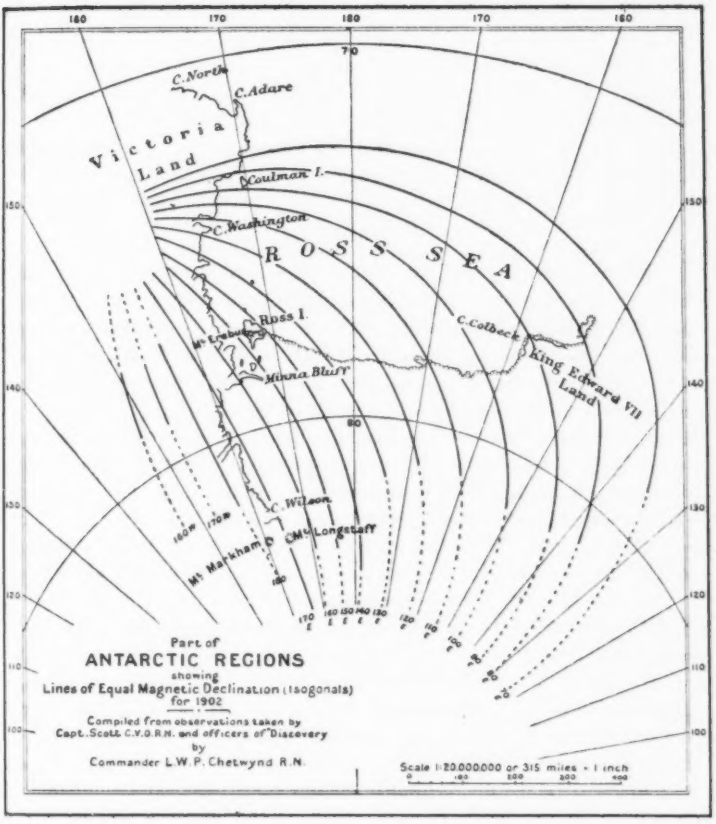
A stream of small bergs, with an occasional large one, sets along the barrier and turns north along the western land. They are delayed in the larger bays and inlets, and hung up on such shoal patches as exist off Cape Crozier, Cape Washington, and Cape Adare. From the latter especially there extends a long string of grounded bergs, where they have appeared to attempt to turn the corner too sharply in an effort to follow the coast. To the westward of Cape Adare, stretching toward Cape North, we saw immense quantities of bergs; but after turning to the north we saw none until we had passed to the westward of the Balleny islands, when they were fairly numerous. I cannot think that the bergs we saw before entering the pack in January, 1902, can have any connection with the Ross sea, but they probably originate to the eastward, and it is interesting to note those seen by Captain Colbeck to the eastward of Scott island.

The size of Antarctic icebergs has been the subject of some discussion, and there is much excuse for exaggeration. Of the many hundreds seen by us very few exceeded a mile in length or 150 feet in height; the vast majority were less than a quarter of a mile across and less than 120 feet high. The largest iceberg we saw was off King Edward's Land, apparently aground. We estimated it as about 5 or 6 miles in length, and it seemed to run back for an equal distance. In this region we also saw some very high bergs, and one is logged as 240 feet.

The proportion of the submerged to the visible part of an Antarctic iceberg was estimated by Sir John Murray as about 7 to 1. I am inclined to think that it is much less, but I have no exact measurements to adduce. My opinion is founded, firstly, on general observation of the depths in which bergs ground (120 to 150 feet bergs do not seem to touch bottom in more than 100 to 120 fathoms); secondly, on an eye estimate of the proportion as indicated in an overturned berg; and, thirdly, on the nature of the ice itself as exposed in the face of the berg or of the cliff from which it has come, the transition from snow to ice is very gradual, and strongly impresses one that the mass throughout must contain large quantities of air. For the above reasons, I am inclined to place the proportion as not greater than 5 to 1. Mr. Ferrar has some data concerning the aëration of ice taken from different parts of a berg, which might help to give an approximation. This factor appears to me of great importance, not only in calculating the mass of bergs, but as giving an indication of the thickness of the ice-sheet covering many parts of the Antarctic lands.

OFFICERS AND CREW OF THE "DISCOVERY."

150
140
130
120
110
100


180
170
180
170
180
70
C. North
C. Adare
Victoria Land
Coulman I.
C. Washington
ROSS SEA
Ross I.
Mt. Erebus
Minna Bluff
C. Colbeck
King Edward VII Land
80
C. Wilson
Mt. Markham
Mt. Longstaff
150
140
130
120
110
100
Part of
ANTARCTIC REGIONS
showing
Lines of Equal Magnetic Declination (Isogonals)
for 1902
Compiled from observations taken by
Capt. Scott C.V.O.R.N. and officers of "Discovery"
by
Commander L.W.P. Chetwynd R.N.
Scale 1:20,000,000 or 315 miles = 1 inch
0 100 200 300 400

Current.

The general drift of the current in the Ross sea is indicated by the direction taken by the bergs. We had the good fortune to recognize a berg on our return along the barrier which we had seen on the outward journey. It had drifted 70 miles to the west in twelve days; but the surface water had been moving at a greater speed, as we could tell by its effect on the ship. The tidal streams do little more than accelerate or retard this current, and it was only occasionally that we were helped in our journey to the south and east by a favouring stream. To the eastward of the Balleny islands the surface water is moving towards the north, but the absence of bergs seems to show that there is no deeper stream in this direction. To the westward of the Balleny islands we did not notice any marked current, and the bergs were much scattered.

The Inland Ice.

The main geographical interest of the *Discovery* expedition must lie in the practical observation of a coast-line from Mount Melbourne, in lat. 74½°, to Mount Longstaff, in lat. 83°, and of the conditions which lie to the east and west of this line. Our previous knowledge extended only to that part which lies between Mount Melbourne and McMurdo sound, and of this we had but the vaguest description.

The outline of the coast and the positions and heights of the mountain ranges are shown on the chart. It will be seen that the coastal mountains are comparatively low between Mount Melbourne and the Ferrar glacier, and it was the tabular structure of these that first indicated to us the horizontal stratification of the mainland. But low as the mountains are, in one place only does the internal ice-sheet seem to pour any volume of ice into the sea, whilst the mountains themselves form an effective screen to the conditions which exist behind them. I have one note only that throws light on these. Looking back over the ice-river in lat. 75°, one saw its surface rise sharply to a ridge between the coastal mountains, and I wrote, "Beyond this the surface still seemed to rise, and bare patches of rock could be seen at a greater altitude, but it was impossible to estimate the exact distance or height of these." As we journeyed inland and upwards on the Ferrar glacier the mountains on our right gradually rose in altitude, and when we reached the interior plateau, at a height of 9000 feet, we observed nunataks to the northward standing above our own level. From these observations, I think there can be little doubt that the land rises beyond the coastal mountains of the whole Prince Albert range, and that the interior ice-cap nearly maintains the altitude which it has to the southward. To the south of the Ferrar glacier there are a number of detached mountain ranges of great altitude that flank the coast. In the distance at which we first saw them they bore all the appearance of islands, but

closer approach not only narrowed the glaciers which lay between them, but showed us further mountains which lay beyond them, and revealed an extensive mountain region, beyond which must lie an ice-cap of great altitude and extent.

It is known that we travelled to the westward over a plain which did not vary in altitude more than 60 or 70 feet for 200 miles, but it will be remembered that one's view on such a plain is very limited, and it would be impossible to state definitely that the conditions are the same for many miles north or south of the line taken. The mild undulations of the plain were sufficient to make a slightly wavy horizon, which could be detected by swinging the levelled telescope of the theodolite, and I am inclined to think that on an average the northern horizon was slightly lower than the southern, but this was not a definite observation.

We did not reach the inland plateau of 8900 feet until we were fully 60 miles from the coast, and it is, therefore, extremely improbable that the full height of the ice-cap of Victoria Land could be seen anywhere from the sea or from the barrier surface. It is certain that the ice-cap is of very great extent, and the evidences which I have briefly sketched serve to increase the impression of its vastness, and to indicate that it maintains a great and approximately uniform level over the whole continent.

Whether we accept what our imagination must suggest, or whether we pause at the actual facts which have been discovered, this great ice-sheet is still unique. The reason for its unexpectedly level surface, the possible maximum thickness, and many other details concerning it, would seem to me to offer a fruitful field for discussion, and on such points I for one should be most grateful for the opinion of experts.

Glaciers.

There are innumerable glaciers on the coast of Victoria Land, but the great majority merely discharge local *névé* fields lying in the valleys of the coastal ranges. Very few run back to the inland ice, and these may be divided into two classes—the living and the dead. In the long stretch of coast between Cape Adare and Mount Longstaff, over 11° of latitude, there appears to be only four living ice-discharges from the inland. The first falls into Lady Newnes bay, the second is the ice-river in 75° S., to which I have already referred, whilst the Barne and Shackleton inlets form channels for the other two. The Skelton and Murdock inlets may actively discharge from the inland ice, but this is doubtful. From observations to which I have referred, there can be little doubt that the movement of the more northerly of these discharges is very slow, but judging by the movement of the barrier, the southern ones are more active.

The Ferrar glacier is typical of the dead glaciers; the ice lies in the valley practically stationary, and gradually wasting away from the

summer thawing. It is to all intents and purposes a dead limb. From lack of time for its construction, the inset chart does not very clearly show the ramifications of this glacier. Several discharges from the inland enter a common basin, from which two arms run towards the sea. Time does not permit me to touch on many interesting points concerning these details, but I may be permitted to refer to an exploration which I made of the "north" arm on my return from the west. Various observations on our outward journey, and whilst our ideas were yet unformed, had led me to suppose that there must be a considerable discharge of ice down this arm, and on my return I determined to explore it. After a day's journey down the glacier the ice became very rough, and we were obliged to leave our sledges and proceed with care. As we continued to descend, the glacier gradually dwindled, and then suddenly ended in the tamest manner in a wall of no great height. In the valley beyond we found some frozen lakes, and yet further in the narrow deep gorges, long lines and confused heaps of morainic *débris*. We walked on, hoping to gain sight of the sea, but were unable to do so. Perhaps in this valley, more than anywhere, lay the evidences of what was happening and what had been.

There lay the glacier inert and dead, whilst the summer sun slowly wasted its huge mass; on either side its shrinking tributaries had already severed their connection and receded up the steep mountain sides; one could no longer doubt a receding glaciation. Not only at our feet lay the morainic heaps to show what the glacier had once been, but thousands of feet up the hillsides they ran, till a clear-cut line showed the extreme limit to which it had once extended.

Here also I saw long morainic heaps 60 or 70 feet in height in the floor of the valley clean cut through by old watercourses, which now contain only the most modest streams; many of the boulders, well clear of the present streams, were quite smooth and rounded, whilst others at a greater height were sub-angular. This water-action must have been quite recent, *i.e.* since the glacier receded.

Mr. Ferrar has, I believe, measured the ancient high-tide mark of his glacier to be between 3000 and 4000 feet above its present level in places, but, of course, found the difference was less in the higher reaches.

The Ferrar glacier probably contains as much ice as any hitherto known in the world; the Barne and Shackleton glaciers contain a great deal more, and since they are now in such a diminished state, it is interesting to think what vast streams of ice they must have been at their maximum. To what extent the inland ice sheet stood above its present level is also interesting to surmise; one would submit a possibility of 400 or 500 feet.

THE GREAT ICE-BARRIER.

TYPICAL ANTARCTIC ICEBERG.

THE WESTERN GLACIER.

The Great Barrier.

It is already known that I believe the greater portion of this great ice-sheet to be afloat. I will endeavour to give my reasons for this belief.

In considering the northern edge on the chart, if the figures showing the height in feet be taken as giving the depth in fathoms, a proportion of 6 to 1 for the submerged part will be allowed, and this I have already given reason for showing is an ample allowance. Since the soundings are given in fathoms, it will be seen that some hundreds of fathoms of water still intervene between the bottom of the ice at the barrier edge and the floor of the sea; but the barrier edge sixty years ago was in advance of its present position, in places as much as 20 or 30 miles, and therefore our soundings lie directly beneath Sir James Ross's barrier, and a considerable distance from its edge. The part that has broken away must therefore have been water-borne, and this, at least, shows the possibility of the remainder of the ice-sheet being afloat for an almost indefinite distance to the south. Had there been any doubt about the flotation of the barrier edge, it must have been dispelled by the fact that during our stay in the eastern inlet, although we had evidence of considerable tidal movement, the ice rose and fell with the ship.

Our long journey to the south was made practically over a level plain. Of this the gradual disappearance and reappearance of land masses over a continually level horizon could leave little doubt, but a yet clearer indication was the uniformity of the barometric pressures. The aneroid readings were recorded three or four times a day, and were frequently checked with the hypsometer. On returning from the southern journey, I tabulated the readings on each half degree of latitude, in comparison with simultaneous readings taken in the ship, applying the necessary corrections. When an empirical correction for a height of 200 feet is applied to the barrier readings, the comparative differences are extremely small, and if anything, the barrier readings are the greater, showing a fall in level, or what is, of course, a more probable explanation, a rise in the barometric gradient. It is fair to remark, however, that this comparison of pressures cannot be an exact method of determining levels under such circumstances. A small difference of pressure may be due to the normal barometric gradient, to local disturbance, or to instrumental error, as well as to a small difference of level. The point I wish to make is that a difference of level of 400 or 500 feet would introduce a discrepancy which could not be overlooked, and no such discrepancy occurs in our observations.

Incidentally, I might remark that the barometric observations made on our sledge journeys are noted in the meteorological record, and it would be of advantage if those taken to the south and west could be

extracted and tabulated, with a view to discovering differences of level. In the somewhat cursory examinations to which I have referred, I omitted to mention that there was an indication of a rise of level at the end of our journey; at this time we were close to the land, in the entrance to Shackleton inlet, where such a rise might well be expected.

As the great ice-sheet moves along the coast of Victoria Land, the thrust of the immense glaciers in the Shackleton and Barne inlets tends to push it from the land, and vast chasms are left between the ice-sheet and the land, partly filled with blocks of *névé* falling from the snow-capped foothills. For many miles from the entrances to these inlets the ice is waved into long curved undulations, and as one approaches them, the waves become more marked, the confusion increases, and cracks and crevasses grow numerous. Within 10 miles of the coast-line at any place there are signs of disturbance, and it can be easily understood that such a region is ill adapted for the sledge traveller.

But without the region of these disturbances, or some 10 to 15 miles from the land, the barrier moves with tranquillity, no ridge or crevass or other irregularity is met with, and the surface presents one monotonous even plain of snow. I submit that, if possible, it is improbable that a mass of ice could be pushing over the land in such an even, undisturbed fashion.

Where the ice-sheet is pushing past the Minna bluff and around the north and south ends of the White island, it is starred into long radial crevasses, running from 10 to 20 miles out from the land. The rifts are so straight, and close so gradually, that on crossing them the sides appear to have been mathematically ruled straight parallel lines. It is scarcely imaginable that such extraordinary uniformity of fracture should occur in an ice-sheet that was resting on the land, where there must be some irregularity in friction and ice-tension tending to divert the straightness of the rents.

In one of these crevasses extending from the north end of White island, Mr. Royds took some serial temperatures. Close to the land he found that the temperature fell with the depth to a mean level of $-9°$, but at a distance of 10 miles from the land he got a different result. Here at first the temperature fell, but deeper it gradually rose again, until at a depth of 19 fathoms the thermometer showed 0°. Deeper than this he could not go, on account of the snow in the crevass. But I think it must be conceded that the only reasonable cause for such a rise of temperature as was observed is the presence of water beneath the ice.

After our observation of the stagnant condition of the ice about our winter quarters and in the Ferrar glacier, the report of the barrier movement came as a surprise. Its discovery was more or less accidental. In September, 1902, I established Depôt A on the exact alignment of a sharp volcanic peak on the extreme end of the Minna bluff with the summit of Mount Discovery, the line running about west-

north-west and east-south-east. On visiting this spot in 1903, Mr. Barne found that the alignment was no longer "on," and thirteen and a half months after the establishment of the depôt he carefully measured its displacement from the original line, and found it to be 608 yards. The direction of its movement must be a little to the east of north, and consequently this figure probably represents the whole movement during the period.

The direction of movement of the ice-sheet is indicated by the vast ridges encountered off the eastern slopes of Mount Terror; here the sheet is pressing up and shearing past the land-ice, raising numerous parallel pressure ridges. It would almost seem possible that the movement was taking place along the inner or outer of these ridges according to the state of the tide. Dr. Wilson, who had the greatest opportunity of examining this region, thinks that there must be a submarine land ridge between Mount Terror and White island, checking the flow of ice in that direction. He also observed that glaciers on the south side of Erebus and Terror, where there is an exceptionally heavy snowfall, are pressing towards the south-west, eventually finding relief around Cape Armitage. That there was some pressure from the barrier around White island was shown by the pressure ridges which were formed on the eastern side of our peninsula. There are many points of interest in the junction of the barrier and the land, wherever it may be, and Mr. Barne has written an interesting account of the ice-disturbances which he saw on his southern journey, which, however, is too long for reproduction here.

I am inclined to place the eastern limit of the floating portion of the barrier near the inlet which we entered in long. 163° W. It is noticeable that the ice-cliff immediately to the east of this has not broken away since Sir James Ross traced it. Mr. Ferrar thought he actually saw a crack about which there was a differential movement of the ice, or, in other words, a tide crack. I reported the barrier surface to the south of this inlet to be undulating; it would perhaps be more correct to describe it as a plain intersected by valleys running east and west, and descending almost to the sea-level; the valleys do not occur at regular intervals, nor are their slopes regular. This disturbed condition of the normally level plain is, without doubt, due to King Edward's Land, but it is not easy to see why the effect should be precisely what it is.

The full extent of this great sheet of ice must, for the present, be merely a matter of surmise. At our most southerly point we saw long snow-capes running out beyond Mount Longstaff and meeting the level horizon; and farther still the mirage threw up small patches of white, indicative of still more distant capes and mountains. The scene to the south was much what it was to the north, and the weather was so bright and clear that we can make at least one statement with certainty. The high mountainous coast-line does not turn to the east, north of the

84th parallel, beyond the slight trend it already has in that direction.* But at such distances one can only speak of the high land. Whether the level surface of the barrier continues to skirt the coast-line for that distance, it is impossible to say, but, for my part, I am strongly inclined to think that it does.

Distribution of Land.

If the high coast-line be carried for 100 miles beyond our position in the direction in which we saw it, it will be seen to be making directly towards Graham Land, and I cannot but think that it continues to do so. If so, the geographical pole would be situated 200 miles or more from it and on the high ice plateau, which must continue behind if we allow for the comparatively rapid movement of the barrier.

The alternative theory held by many is that the coast sweeps round somewhere and joins King Edward's Land; if so, the turn, as I have pointed out, must be made a very long way south. Unfortunately, our knowledge of King Edward's Land is cursory. Judged by the outline of the hills and the blackness of the rocks, it appeared to be of the same comparatively recent volcanic formation as the land in the immediate vicinity of our winter quarters, but pieces of granite were brought up with the lead from the shallow water in its vicinity. In the region of Cape Colbeck the land is covered with a high-domed snow-cap, but to the eastward we had a long clear view of numerous peaks. Beyond those which fronted the coast-line were others at a greater distance, which gave a depth to the view. But we saw nothing like the wild rugged mountain scenery of Victoria Land.

Speculation on Former Conditions.

It is obvious that when the southern glaciation was at a maximum, when the glacier valleys were filled to overflowing, and when through all of them the great reservoir of inland ice was pouring vast masses into the Ross sea, the Great Barrier was a very different formation from what it is at present, and, as Mr. Ferrar has pointed out, there are abundant evidences of its great enlargement. Granite boulders are found on Cape Royds and high on the slopes of Terror, erratics, which can only have come from the mainland. On the slopes of Terror Dr. Wilson found morainic terraces 800 feet above the present barrier surface. Mr. Ferrar has shown that nearly the whole of the Cape Armitage peninsula was at one time submerged in the ice mass, and, in fact, on all sides of us, and everywhere, were signs of the vastly greater ancient extent of the ice-sheet.

It is not until one has grasped the extent of the former glaciation

* As showing how far objects may be seen in the clear atmosphere of the Antarctic, at one and the same time we saw Coulman island and Mount Erebus, although separated by 4° of latitude.

SOUTHERN EDGE OF PACK-ICE AND OPEN ROSS SEA, LOOKING SOUTHWARDS.

OVERTURNED ICEBERG.

and the comparatively rapid recession of the present that one can hope to explain the many extraordinary ice-formations that now remain in the Ross sea. I advance such an explanation with all deference to the distinguished audience which I address. I do not doubt that there will be disagreement with my conclusions, but if it leads to discussion, we may all benefit.

I am of opinion that at or near the time of maximum glaciation the huge glaciers, no longer able to float in a sea of 400 fathoms or more, joined hands and spread out over the whole Ross sea, completely filling it with an immense sheet of ice. At that time the edge of the sheet, and the first place at which the ice could become water-borne, bordered on the ocean depths to the north of Cape Adare. Then followed the receding ice-conditions, and at length a time when the ice-sheet was very curiously circumstanced. The Ross sea is very uniform in depth, north and south; the ice-sheet that pressed out over this level bottom would consequently be more or less uniform in thickness, and finally, the wastage would be more or less uniform over the whole area. As a natural consequence of such conditions there came a time when the whole ice-sheet became buoyant, and either it had to break away with great rapidity or to float whilst remaining fast. It floated and broke away gradually, and the present rapidly diminishing barrier is all that remains of the great ice-sheet; or rather, it is not all that remains, because I think that the whole coast bears signs and remains of the old barrier in curious ice-formations which can be accounted for in no other way. Lady Newnes bay is filled with a fragment of the barrier; the present ice discharges are wholly insufficient to account for such a sheet; moreover, its surface is not gradually inclined, but advances in long and steep undulations, the outer waves cut off by deep hollows from the interior mass. A single deep sounding in an inlet showed that here, too, the greater part of the ice-mass is probably afloat, and that it is held in by its exceptional land surroundings.

A still more curious fragment is the long tongue of ice, extending from the land in lat. 75°. Not only is its plan outline against the supposition that it can be fed by the ice-sheet, but at the outer end it is considerably higher than at the inner. Off the outer end we got soundings of 400 fathoms, which increases the difficulty of accounting for the continuance of such an unsupported mass of ice in its present position. But in this respect the same difficulty was emphasized in connection with a more wasted ice-tongue of the same description which jutted out from the slopes of Erebus within 8 miles of our winter quarters. This was a very long lathe-like tongue with serrated edges, and afforded us many arguments. I was with Captain Colbeck when he sounded off the end and at various spots on either side; nowhere could we get anything but very deep water. But the problem of how these

tongues remain at anchor has no bearing on their origin, and is, therefore, somewhat of a digression.

I would take, as another typical remnant of the greater ice-extension, one of the numerous steep snow-slopes that fringed the sea about our winter quarters. They start on a steep bare hillside, and, wedge-shaped in section, gradually increase in thickness till they end in a perpendicular cliff dipping into the sea. This feature in a modified form is reproduced along the whole coast-line as far south as the northern end of the White island. Yet one other formation deserves mention, namely, that which, for want of a better term, I may call the fan-shaped glaciers which lie under such steep cliffs as those of Coulman island. These are to some extent fed by the ice-cap above, but their size is out of proportion to such a supply, and they end in steep high cliffs often more than 100 feet above the sea. These too, I think, must be regarded as the last clinging remains of the old barrier.

I have probably wasted too much of your time in attempting to elucidate these ice problems, but I feel that the subject is one of great interest and worthy of discussion. I do not know that I have advanced anything startlingly new, but what I wish to generally impress is, that the majority of curious and often vast ice-formations met with in the Ross sea must be regarded, not as the result of present-day conditions, but as the rapidly wasting remnants of a former age.

Climate.

It has been a surprise to me to find that the idea that a great glacial epoch is the result of a comparatively mild climate is supported by much authority. Both Mr. Ferrar and I arrived at this conclusion independently when in the Antarctic. The chief argument is, of course, that it is physically impossible for cold air to contain much moisture, but, living in a severe climate, it was impossible not to realize that greater severity would have meant more sterile ice-conditions. In this connection it is interesting to note that our greatest snowfall occurred in the summer, and that the Balleny islands are more actively glaciated than Victoria Land. We observed two large avalanches of *névé* as we passed Sturge island. There can be little doubt that at the period of heavy glaciation the climate of Victoria Land was far milder than it is at present.

I should like to contribute some facts which may be of interest to meteorologists. Mr. Shaw has congratulated us on the possession of such an excellent beacon as Mount Erebus, from which we could gather the direction of the upper air currents. In this connection there were some interesting evidences to be gathered from the surface of the snow on the high level plateau of Victoria Land. The high hard winter sastrugi uniformly point between west by south and west-south-west; when we arrived on the summit, the wind was a little

THE GREAT CHASM.

MOUNT EREBUS WITH SMOKE.

south of west-south-west, and fresh light sastrugi had formed in that direction. During our stay the wind crept gradually round to south-west, and once or twice it went further south, with a rise of temperature and light snowfall. I gathered, firstly, that throughout the winter the wind blows from west-by-south, but during the summer creeps more to the southward; and, secondly, that there is no snowfall except in the summer, and on the rare occasions when the wind blows almost due south.

Erebus smoke blew almost persistently to the east, but we could not always exactly gauge its direction. It is curious to find that every sketch made by the Ross Expedition shows it going to the west, and Sir Joseph Hooker can remember it going in no other direction.

I understand that Mr. Shaw is of opinion that the south-east winds recorded in our winter station are not merely local. I should be glad to think it was so, but the weather conditions about the *Discovery* seemed to me too confused to allow it. It was often possible to see very varying weather conditions simultaneously at different places within our view. For instance, at one time a bank of heavy nimbus cloud overhung Cape Bird; the northern slopes of the western range were in calm and sunshine; clouds of drift were being swept from the slopes of the *Discovery* by a southerly wind. The wind was south-east at the ship, whilst off Cape Armitage and a mile or two to the eastward of our peninsula it was again calm. The same confusion was shown by the snow-waves. As a rule, in the vicinity of the ship they pointed to the south-east; outside White island they were very confused, from west-south-west to south-south-east; south of White island and to the Bluff they were south, at the depôt south-west, and off the eastern slopes of Terror again south.

At the eastern end of the barrier the winds we experienced were certainly east and south-east, but if this is the prevalent direction over the whole barrier, it is difficult to see where the body of air goes to unless it turns to the north on arriving at Victoria Land; it certainly does not go over the mountains and plateau. It is certainly deplorable that there should be no way of measuring the Antarctic snowfall. The most efficient instrument, however, would have been useless in the vicinity of the ship, as our small bay was a focus which received far more than its due share of snow. When the ice about Cape Armitage was a year old, it occurred to me that we might get a rough idea of the net annual deposit by measuring the depth of snow at various points on its surface. This was done with difficulty, owing to the sastrugi and varying nature of the snow, but I calculated that a rough average of the results would represent between 4 and 5 inches of hard-packed snow. Rough as it is, this figure is something of a guide, for it means that the surface of the barrier is annually augmented by about this amount. It may be added that excavations into the surface of the barrier invariably revealed a succession of crusts at irregular intervals. The amount of snow between

the crusts was not much in disagreement with the deposit above mentioned. Even an annual increase of this amount would account for an absence of boulders or dirt in any visible portion of the barrier edge.

In mentioning the deposition on the barrier, I cannot refrain from carrying the same problem to the ice-cap and hazarding a solution for a curious condition of the surface which puzzled me much at the time. In journeying to the west we crossed numerous slight inequalities. Where the surface inclined to the east, it was covered with hard sharp-edged sastrugi, but elsewhere it was quite smooth and covered with a shiny crust traversed by innumerable transverse cracks, which gave it a scaly appearance such as may be seen in the mud of a dried pond. I felt at the time that this was no recent formation, but it was only much later that it occurred to me that this might be a sign that there was no net deposit of snow on this great plateau, or, in other words, that the climatic conditions were such that the evaporation equalled or exceeded the deposition. Before quitting the subject of meteorology, which I am very loathe to do, I must add that the warm snow-bearing southerly winds which we experienced have not yet been explained. Even in the depth of winter this wind had sometimes a temperature of $+10°$ to $+15°$. Presumably the air was in the process of being rapidly cooled, and was depositing its moisture. If it had been heated adiabatically, whence comes the moisture? Mr. Royds may have had some such idea in his mind when he spoke of a "föhn" effect, and I am not quite clear as to Mr. Shaw's reference to this. He remarks, "Wind in those regions may carry snow with it without being necessarily a very moist wind." If this implies that the snow was only drift-snow, I fear he is not quite apprised as to the conditions. Although it was impossible to measure the snowfall, it was generally easy to distinguish between snowfall and snowdrift, and in the case of our southerly winds there is no doubt whatever they are accompanied with falling snow. It will be noted, also, that a comparatively warm southerly wind brought snowfall on the summit of Victoria Land, and at our farthest south position we experienced precisely the same effect.

I must regret that since my return to England I have not had time to keep myself fully informed of the progress of the scientific work of the expedition, in which we all, whether scientists or laymen, must continue to take a deep interest; but we know that it is in good hands, and can hope that the best will be made of the raw material which has been brought back.

It is a disappointment to all that Mr. Ferrar's fossils should not have been in a fitter state for identification, but it is some consolation to know that it is the fault of nature, and not of the discoverer, that they should tell so little; and it is a great satisfaction to find that geologists have already found so much that is interesting in Mr. Skelton's photographs and in Mr. Ferrar's brief summary, that we may look for much

light being thrown on the geological formation of this great land mass when the latter's voluminous notes are brought into shape. Mr. Ferrar has already described how he found an immense sandstone formation, 2000 feet in thickness, practically horizontally bedded on a granitic base and capped with basalt; the simple horizontal structure seems to have been wholly unexpected, and the absence of lateral pressure in the formation of such a huge and extensive range of mountains appears most remarkable. It cannot but be regarded as singularly fortunate that we should have found such an excellent natural geological section of the range as was exposed in the steep cliffs of the Ferrar glacier, and if the simple formation thus discovered be regarded as typical of the whole mountain range (and there is some evidence that it may be), the geology of the Antarctic continent will have received an immense addition.

The more recent volcanic outburst which has thrown up the high conical peaks of Erebus, Terror, Melbourne, Discovery, and a thousand minor craters along the coast-line, must also be of great interest. It occurs to me to add here that geology will owe much to the careful charts which are now being prepared by Lieut. Mulock from a very large amount of survey data.

I am glad to have been informed that an unfortunate error with regard to the hours named for term day magnetic observations is not of such importance as was at first imagined, and, of course, the curves taken under normal conditions are of unimpaired value. It must be long before the full magnetic results are known, but Captain Chetwynd has already found that the observations for "variation" taken at sea and on sledge journeys work in remarkably well.

Dr. Wilson's work on vertebrate zoology, in a region where vertebrate zoology ends, is already fairly well known, but all who have listened to him or have seen his sketches must realize that he will have much more yet to say on his subject. Mr. Hodgson has already furnished a preliminary paper to this Society, and his work must necessarily take a long time to investigate.

I am not aware of the fate of the seismic, the pendulum, or the auroral observations, or of those taken for atmospheric electricity; but as I know all were taken conscientiously, I feel sure all must be of value. I am also in ignorance at present with regard to tidal observations; very great care was taken to eliminate or to allow for all chances of error in these observations, and it is therefore to be hoped that they will yield good results.

Time has obliged me to leave many interesting points untouched in this paper, but I must briefly refer to our geographical exploration to the northward and westward of Cape North. I have already shown the probable cause of Ross's error in imagining the Russell islands to be a separate group from those discovered by Balleny, and I have

described our course to the westward. But with reference to the latter, I would add that, whilst it is certain that we must reject Wilkes Land to the eastward of Adélie Land, Wilkes' soundings still remain as a guide to the limit of the continental plateau in this region. Our own uniform soundings of 250 fathoms to the south, together with his, show that there is a considerable extent of shallow sea, limited more or less by the track of Wilkes' ships.

After the paper, Sir JOHN MURRAY said: I do not propose to offer any remarks by way of criticism, but I should like to express my very high appreciation of the manner in which the work of this expedition has been carried out, and the large additions to knowledge which it has furnished. I have listened with very great interest indeed to the interpretation which the leader of the expedition has given to very many of these observations. No doubt he has studied the thing upon the spot, and is, therefore, very much more capable of forming a judgment as to the general distribution of the land and the ice than any one else. Still, it seems to me that, so far as he has been able to place the observations before us, I would not like to say that he has conclusively shown that all that great ice-barrier over which he travelled was necessarily afloat—that is to say, that it had salt water underneath it. That it is afloat at its outer edge, and that salt water may extend for 30 or 40 miles underneath is quite probable, but I should not like to admit that the whole of that barrier was really afloat. This ice barrier has, it appears to me, a direct connection with the great mass of snow on that high land. Thus alone can I account for its motion to the north as observed by the members of the expedition. One thing I quite agree with, and all the observations which have been made go to show that at the present time there is a retreat of the ice in this region. That it has retreated all over the Antarctic Regions is extremely probable; but it is certainly in a dying-out condition—that is, it is far from being at its maximum at the present time. That, I think, may be admitted as thoroughly proved. With respect to where the great mass of the land lies, I should say that it lies in the direction that has been indicated by the leader of the expedition. The rocks that the *Challenger* dredged up within the Antarctic circle consisted of all the kinds of rocks that are usually found upon continents, and we all of us firmly believed that within that region there was a great continental mass. That has now been proved by the observations of the *Discovery*, and that, I think, is a very great point indeed. I have read some of the other communications that have been given by other members of the expedition of what has been accomplished in the various departments, and I for one will yield to no one in the appreciation I have of the most excellent work that has been done by this expedition, and the great contributions to human knowledge which it has furnished.

Mr. J. J. H. TEALL: I am very glad of the opportunity that you have given me of associating myself most thoroughly and completely with the remarks which Sir John Murray has made as to the importance of the results which this expedition has brought forth. Like him, I do not feel able to enter into anything like a discussion of the problems which are suggested by this communication. It is given to all expeditions of this kind to extend our knowledge, to push back the boundary between the known and the unknown, and in doing so to set at rest a number of points on which we were previously in doubt, and to bring prominently to the front new problems which we wish to have solved. I think, sir, that so far as regards actual results achieved, this expedition will certainly rank with any other expedition of its kind, and so far as problems suggested are concerned it is

equally fertile. In listening to this most interesting account of the ice phenomena given by Captain Scott, many problems of the greatest interest suggest themselves. I am not going to detain you with all those problems, but there is one that I would just like to refer to. He has proved in the most convincing manner that this ice-sheet, which is not far removed above the level of the Ross sea, and which he believed to be afloat, is moving towards the north at quite a respectable rate—600 yards, I think it was, in about a year—and yet the ice which comes down from Victoria Land on the west does not contribute to any appreciable degree to the ice-barrier. And, moreover, those glaciers which move down from the west either end off short at the coast, or at any rate do not move on towards the coast and into the sea to any great extent. It is a most remarkable fact, because if the ice of the southern extension of the Ross sea is moving north, it must get its supply from somewhere, and from somewhere where the precipitation, one would imagine, must be very much greater than that of this region. How does that mass of ice moving towards the north obtain its supply? That is the question. Are we, as Captain Scott has hinted in those conclusions of his, witnessing the disappearance of a glacial period? It is certain that the ice phenomena are dwindling. Does this constant movement towards the north mean that the ice, which accumulated in more southern regions under climatic conditions quite different from those which now exist, is fading away? That is a problem that we cannot solve. We want more expeditions. We wish Captain Scott would go again and get up some 9000 feet, say on Mount Longstaff, and see what there is beyond. I am sure nothing would give all of us greater pleasure than to hear that such a thing was possible; but I fear that for the present we shall have to be content to study the data that have been collected by Captain Scott and his colleagues with the greatest possible care, and then formulate problems to be solved by further research.

Mr. Lamplugh: I am afraid there are many points in Captain Scott's paper of a technical character which would not be interesting to discuss on this occasion. There are two questions, however, which I should like to ask Captain Scott. In studying the glaciation of the British Islands we find evidence of two large ice-sheets covering the seas, one covering the North Sea basin, and the other covering the basin of the Irish Sea. In the barrier ice described by Captain Scott we seem to have a mass of ice resembling that which formerly covered our sea basins. These ice-sheets do not seem to have accumulated entirely from the flow from the mountains. I would ask Captain Scott whether he would consider it to be possible, if a sea were frozen over or covered with pack-ice permanently, for a thick mass of ice to form gradually by the excess, under favourable conditions, of the winter snowfall over what would melt away in the summer? Is it possible that in this way there might in a closed basin be an ice-sheet formed without drawing upon mountainous land at all? There is another question with regard to the Ferrar glacier. Captain Scott spoke of finding that the northern arm ended upon the land, while the southern or main arm ends in the sea. Apparently, although the ice flowed down the north valley, yet it was moving up the land slope, because the bottom of the main valley sank below sea-level, whereas the said arm ended upon the land. This would be a very interesting case if I am right in my interpretation of the facts; it would look as if this ice were flowing over an old land surface. That is a point upon which I should like to have Captain Scott's opinion. Then, among many other matters largely involved in these observations, there is the question as to the cause of the Glacial Period. It seems now to be conclusively shown that the ice is melting away very rapidly in the Antarctic. It has already been proved that the same thing is happening in the Arctic. We seem at the

same time to have a disappearance of the ice both in the north and south. This tells strongly against the theory of alternating glaciation, and alternating interglacial periods. Of course, there are very many other points which we shall have to consider, but I mention these, and I hope that Captain Scott will give us the benefit of his opinion upon them.

Dr. MILL: At this hour of the evening, I cannot profitably add anything to what has been said by the other speakers, but I cordially agree with them in their remarks as to the problems that have been elucidated by the researches of the *Discovery*, and as to the other problems that have been raised and remain for future solution. I am particularly in agreement with what Dr. Teall said as to the extreme importance of the expedition being in due time followed up by another. There should be continuity in carrying forward that research which begun at the time of Cook, 130 years ago, and has since proceeded step by step, every fresh expedition building itself upon the experience of its predecessors. There are one or two statements in Captain Scott's observations which interested me especially, because he has, entirely independently, come to conclusions with regard to the causes of the Antarctic icebergs and the ice barrier similar to those suggested by his predecessors a long time ago; the most interesting of all is that of the great barrier being entirely afloat, confirming in a remarkable way the reflections of Biscoe that Antarctic icebergs were the result of frozen sea-water and the fall of snow "accumulated with time." All these problems could stand a great deal of discussion, and this they will undoubtedly receive; but this evening, I am afraid, is hardly the time for entering upon any new matter of a controversial nature.

The PRESIDENT: Mr. Teall has suggested that birds might be near the south pole. I think Mr. Bernacchi would be able to tell us that, if it is the case. He saw a white petrel flying due south, and obviously it had some object in view.

Mr. BERNACCHI: I am afraid I did not quite catch the point of the President's question, but with regard to the white petrel that we observed on the ice-barrier, it was seen while on the sledge journey undertaken by Lieut. Royds and myself across that barrier, and nearly at our farthest point south-east from Mount Erebus —that is, at a distance, I should think, of 120 miles from the sea. What it was doing there I have not the slightest idea, nor have I the slightest idea where it was going.

Captain SCOTT: I would remark again that I do not claim to have actually proved that the Great Barrier is afloat far to the south, I merely point to strong suggestive evidences; but I cannot quite see why Sir John Murray should limit its flotation to 30 or 40 miles. If it is water-borne for 30 or 40 miles, why not for 100 miles or more? Mr. Lamplugh's questions are difficult to answer verbally and at short notice. With regard to the possibility of an ice-sheet being formed in an enclosed sea without its being fed from a mountainous country, I can imagine, without being an expert, that such a thing would be quite possible. I see no reason why an ice-sheet should not be formed at a low level in the same manner as it is formed on the high plateaux of a mountainous country given similar climatic conditions. With reference to the possibility of the north arm of the Ferrar glacier having been a feeder rather than an outlet of the glacier basin, I fear my remarks must have been obscure, as they did not convey the fact that in this valley we were travelling downwards and towards the sea. I think if I were to explain the topographical features to him, it would leave him in no doubt that the valley ended at the sea, a few miles beyond where we saw it, and that the glacier was an outflow which had wasted back. I am not very clear with regard to the third question concerning the inter-glacial period. If it suggests the possibility that the ice has receded and is now again advancing, I would reply that I

think there is no doubt that this is not the case. The rate at which the ice is now melting, coupled with the absence of movement, points to a present-day recession. Of course, there are a great many facts which I have not been able to enter upon to-night which would bear upon the subject.

The PRESIDENT: It only remains for us to thank Captain Scott for his most important and interesting paper. He has thrown great light upon a most important part of the Antarctic Regions. He has given us a new standpoint whence to draw conclusions on the geography of the whole region. I propose to you, and I am sure you will join with me in passing, a very cordial vote of thanks to Captain Scott for his most valuable paper.

Mr. W. N. SHAW, F.R.S., sends the following remarks:—

I am glad of the opportunity of adding to the remarks I made with reference to Mr. Royds' paper, since Captain Scott has referred to them, and has raised some questions with regard to them. The first point is whether the winds at the winter quarters can be regarded as merely local winds. The best evidence with regard to this would be the barometric gradient. If the average barometric gradient is northward, there will be some kind of easterly drift. I do not yet know what evidence there is about the gradient, but in the mean time it is gratifying to know that the direction of the wind was most frequently from some easterly direction, because it points, in so far as it points at all, to some sort of circulation from the eastward about the pole of cold.

The other point I wish to refer to is the possible occurrence of snow in a dry wind. Parenthetically I may say I should be glad of Captain Scott's method of distinguishing between drift snow and falling snow, but it would not be important for this question, which, I take it, is really the question whether the air through which snow is *falling* is the air in which it has been formed. The answer of any physicist to the question put in that way is "Certainly not;" but to the further question whether the air through which the snow is falling is similar, as regards humidity, to the air in which the snow was formed, the answer is not so easy. It is sometimes difficult to believe, when we get rain here with an easterly wind, that the raindrops are formed in the easterly current, and not in some upper current. And snow is even more likely to find itself carried along in a surface drift in which it was not formed. For the humidity we have still some unsolved problems about the dryness of air over the sea, and we know so little about the conditions of evaporation and saturation at very low temperatures that it would not be wise to assume that we know the hygrometric state of the air from the fact that it is carrying snow-particles.

II. NOTES ON THE PHYSICAL GEOGRAPHY OF THE ANTARCTIC.*

By H. T. FERRAR, M.A., F.G.S.

THE following notes do not in any way pretend to be complete, but are intended to be an introduction to the physical geography of the area allotted to the *Discovery* in the international scheme of work in the south polar regions. No geological sequence is given, but the rocks are considered in the order in which they occur in the field, and this order may be taken as a guide to the relative ages of the rocks.

* This and the paper by Lieut. Royds were read at a meeting of the Research Department on February 6, 1905.

The maps indicate the positions from which specimens were obtained, but cannot be taken as accurate; nor can the height at which the ice once stood be considered exact, for all the evidence on this point has not yet been collected together.

If you will allow me to read my paper instead of lecturing from notes, I shall be greatly obliged; for I find that in lecturing the great difficulty is to bring the main points to notice, giving due prominence to each in turn. There are many points, such as the "Structure of the ice," or "Ice as a geological agent," which I have had to ignore entirely, for want of space; but these and many other points, I hope to be able to enlarge upon later.

The History.

Captain Cook, in 1774, circumnavigated the Earth in high southern latitudes, proved the existence of a circumpolar ocean, and showed that in all probability there was a great mass of land there. The most striking information he obtained was the isolation of the mythical Antarctic continent, but it was in about 110° W. long. and 71° S. lat. that the evidence of the presence of land was greatest; however, no more definite knowledge as to the amount of land in high latitudes was obtained until the Australian whaling fleet made inroads into these unknown seas. It is noteworthy that every expedition tends to show the amount of land to be less and less, although there is hardly room now, as so much is known, to decrease the size of the Antarctic continent to any great extent.

Land was discovered at or near the antarctic circle by the whalers Kemp and Balleny * early in the nineteenth century, but it was not until 1839 and later, when an international attack was made on the south polar regions, that the nature of the land could be guessed at. The Russian expedition, under Bellingshausen,† and the American squadron, under Wilkes,‡ augmented Cook's work; but the first geological specimens were obtained by the French expedition under Dumont-Derville,§ when a landing was made on what is now known as Adèlie Land. Balleny, the captain of one of the ships of the enterprising Enderby of London, and Weddell of the same firm, made important inroads into the Antarctic, which have been subsequently used by exploring ships, but need not be mentioned here, as this paper proposes to deal only with South Victoria Land.

This land was discovered by the Ross ‖ expedition (1839–1841), and his discoveries may be summed up thus—

1. An extensive range of mountains of very great altitude, abutting the open sea, and ending very sharply in that sea. Ross's ships, the *Erebus* and the *Terror*, were not near enough to prove the continuity of the whole, nor to see any structure in them.

2. An open sea, with comparatively shallow soundings, but which shelved to great depths in about lat. 65° S., as if off the edge of a continental shelf.

3. Volcanic cones, or strictly volcanoes, one of which, Erebus, is still active.

4. A great wall of ice, 470 miles long, and of varying height, with a sheer cliff-face, facing the north.

5. Specimens of rock from the Possession islands. One specimen is a hornblende basalt,¶ and, owing to the nature of this rock and to the presence of

* *J.R.G.S.*, London, **9** (1839), 517–526.
† 'Journal des Voyages,' **14** (1822), 126–128. Book published, 1831.
‡ 'Wilkes' Narrative.' Philadelphia: 1845.
§ 'Histoire du Voyage.' 1845.
‖ 'Voyage to the Southern and Antarctic Regions.'
¶ Teall, Jermyn Street Collection.

THE EDGE OF THE ROSS ICE-SHEET.

PINNACLED ICE FLOATING IN M'MURDO BAY.

mountains such as Erebus and Terror, McCormick decided the whole range was of volcanic material.

In 1874 H.M.S. *Challenger*, under Nares, crossed the Antarctic circle, and, in dredging, obtained specimens of archæan rock, which made it probable that these rocks formed part of the Antarctic continent. Specimens of quartzite are recorded from the Possession islands,* from Cape Adare, as well as in the *Challenger's* dredgings, but no importance was attached to these finds.

The *Southern Cross* expedition, which was the first to spend a Winter in South Victoria Land, to some extent amplified the observations of Ross, as regards the volcanic rocks; but in addition this expedition brought back Palæozoic quartz grits,† but unfortunately no fossils were found in these, though they are undoubtedly of sedimentary origin; also plutonic rocks, such as granites, but no specimens of these had been recorded *in situ*.

The Rocks found.

A landing was made from the *Discovery* on Cape Adare on January 9, 1902, and a collection, chiefly of volcanic rocks, was made; but there was no suspicion of the presence of other than igneous rocks until, in the operation of dredging near Coulmon island, several white fragments of granular quartzite were brought up. The probability of the presence of a sedimentary rock was further increased by sighting, just south of Mount Melbourne, a typical tabular mountain with what may turn out to be bold escarpment slopes; and again, when a landing was made in a harbour in lat. 76° S., on a denuded granite massive, small boulders of quartzite were found. On Mount Terror, basic lavas, granite boulders, tuffs, and quartzite boulders were found, but still there was no sign of sedimentary rock *in situ*.

When Lieut. Armitage, in December, 1902, made his pioneer journey into the Royal Society range, he found a horizontally bedded rock of great thickness exposed along the whole length of the ice-stream, but eventually disappearing below the inland ice, and brought back specimens of quartz grit, so that now the presence of a sedimentary rock *in situ* in the vicinity of our winter quarters was an established fact.

In addition to the above rocks, phonolites were found in several localities on the islands around Winter Quarters, and a coarse tuff, similar to the Possession island palagonite tuff.‡ occurred as a prominent crag bursting through the snow on the south side of Mount Erebus.

In the Royal Society range, at a later date (November, 1903), a gneissic platform was found, which is probably of archæan age, and above it occur the following rocks in order from below: granites, sandstone, basalt.

The granites appear to be of two ages—the one is peculiar in having a horizontal upper surface, which can be seen stretching for 15 miles without a break; the other appears to be intrusive, but its exact position has not yet been determined.

The sandstone, which I propose to call the Beacon Sandstone Formation, is 2000 feet thick, and appears to cover an area of 50 by 20 miles, and possibly ten times as much, but there is no direct evidence for this.

The basalt caps the Sandstone over a considerable area, and forms the well-known plateau feature so characteristic of that rock.§ The original plateaux have been dissected by denudation, and probably also broken up by faulting.

---

* Prior, *Min. Mag.*, **12**, "Antarctic Rock-specimens."

† Prior, "Southern Cross Collections," *Brit. Mus. Nat. Hist.* publication, p. 325.

‡ Prior, *Min. Mag.*, **13**, "Antarctic Rock Specimens."

§ Harker, 'Skye Survey Memoir,' plates ix. and x.

The basalt forms the highest ground that has been ascended in South Victoria Land, and in addition it occurs as dykes and sills in the Sandstone, and is, therefore, evidently a younger rock. It is first met with near the 7000-foot contour, and is also seen at the Depôt Nunatak, 8000 feet above sea-level. It appears to be columnar throughout, and numerous columns up to 12 feet in diameter and perhaps 500 feet high were observed 80 miles from the sea and 120 miles from the ship.

The fossil plants were found close at the base of the basalt in a thin carbonaceous seam not more than $\frac{1}{8}$ of an inch thick. After my party, Kennar, P.O., and Weller, A.B., had been laid up for six and a half days on the edge of the inland ice, we made our way back to Depôt Nunatak, which we could only get occasional glimpses of through the snow-drift. Here we spread our gear out to get rid of the snow accumulated in it during the lie up, and in the moraine I found very suggestive traces of organic matter. I at once made across the South-West arm of the great glacier we had ascended, to a spot where the Beacon Sandstone could be seen just appearing below the "capping" basalt. We arrived at this spot, had lunch, and imagine my delight, when taking my bag and hammer up to the rock-face, to find this "coal-mine," as I may call it, staring me in the face. Finding the seam to be much charred, I set off next day diagonally down the valley to a spot on the left bank of the glacier where 2000 feet of the sandstone was exposed, and of this, 1500 feet proved to be accessible, and was examined.

However, no better specimens could be obtained, neither could the base of the sandstone, nor the platform on which it rested, be seen here or at any other spot visited during this memorable sledge journey.

The Topography.

South Victoria Land consists of a great range of mountains, which reach in an almost continuous belt from the latitude of Cape Adare to the latitude of Mount Longstaff, a distance of 800 miles or so. The heights vary from 15,000 feet, of which there are three or four peaks of that height, to 4000 feet, and it is remarkable that there is no extensive area of land of a less height than 4000 feet.

This range appears to be the eastern extremity of a great mass of land, and buttresses a vast interior ice-field,* traversed for 200 miles by Captain Scott in a westerly direction. Captain Scott found this inland ice to be of an almost uniform level, and to maintain this level at a height of 9000 feet above the sea. This inland ice drains into the sea through valleys at right angles to the length of the mountain range (see the charts published by the Royal Geographical Society), and in this way gives rise to two of the largest glaciers in the world.

In the latitude of Cape Gauss (I use this term, as nothing very definite has yet been fixed on this part of the coast) the land falls to only heights of 4000 feet, and there is a long stretch of coast which is very similar to the west coast of Greenland, and made familiar to us in Von Drygalski's detailed work of that area. These features are: a comparatively narrow belt of inferior height, ending sharply at the sea-front, through which glaciers or ice-streams (if we use Drygalski's nomenclature) break, on their way to the sea from the inland ice. These ice-streams are very similar to those of Greenland, in that their length between the land forming their sides is more nearly equal to their breadth than is the case with Norwegian or Alpine glaciers.†

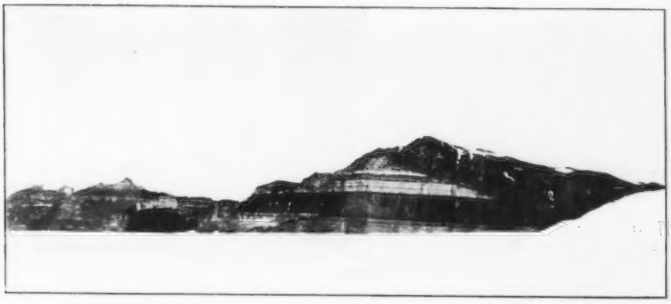
In addition to the main mountain range of South Victoria Land, we have isolated volcanic cones or volcanoes, though only one, Mount Erebus, is now active.

---

* Bernacchi, 'To the South Polar Regions.' 1901.

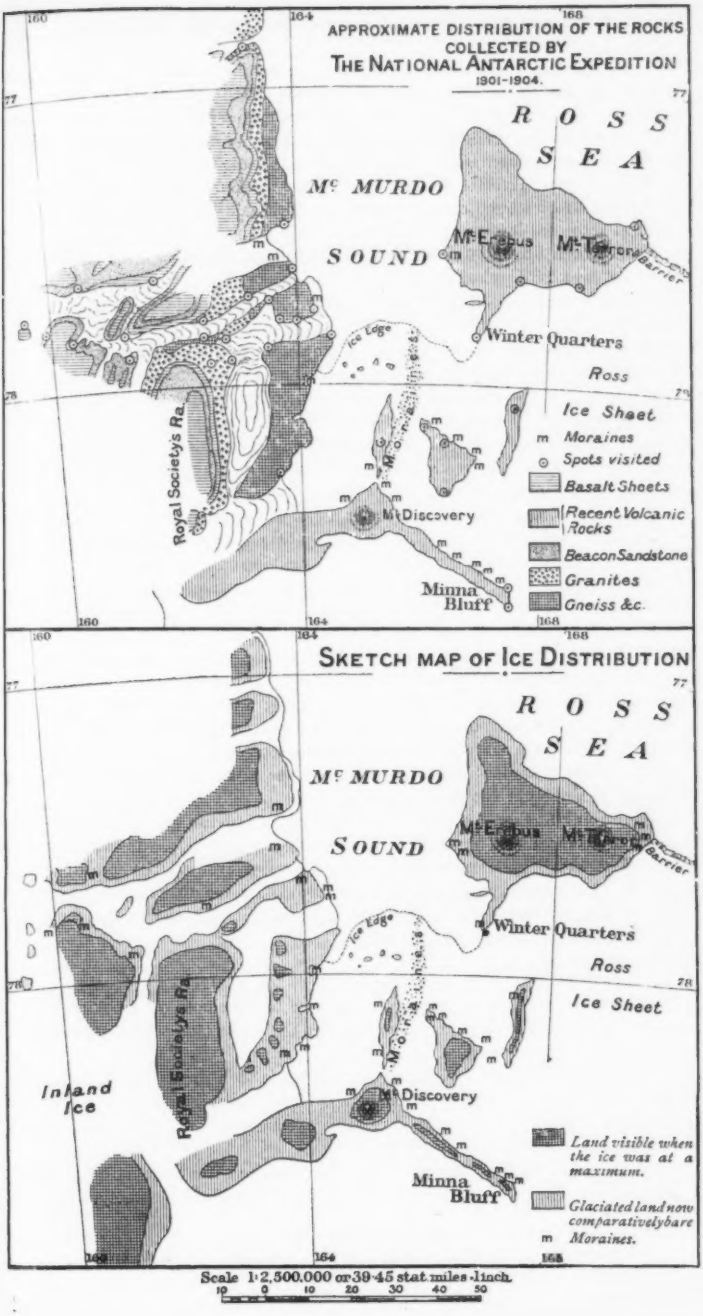
† Heim, 'Gletscherkunde.' Stuttgart: 1885. Classification of Glaciers.

THE CHANNEL BETWEEN THE ICE AND THE BARE ROCK.



BEACON HEIGHTS. SANDSTONE AND BASALT.

LOOKING UP FERRAR GLACIER FROM THE ENTRANCE.


APPROXIMATE DISTRIBUTION OF THE ROCKS
COLLECTED BY
THE NATIONAL ANTARCTIC EXPEDITION
1901-1904.
ROSS SEA
Mc MURDO SOUND
Mt Erebus
Mt Terror
Barrier
Winter Quarters
Ice Edge
Ross Ice Sheet
Royal Society's Ra.
Mt Discovery
Minna Bluff
m Moraines
Spots visited
Basalt Sheets
Recent Volcanic Rocks
Beacon Sandstone
Granites
Gneiss &c.
SKETCH MAP OF ICE DISTRIBUTION
ROSS SEA
Mc MURDO SOUND
Mt Erebus
Mt Terror
Barrier
Winter Quarters
Ice Edge
Ross Ice Sheet
Inland Ice
Royal Society's Ra.
Mt Discovery
Minna Bluff
Land visible when the ice was at a maximum.
Glaciated land now comparatively bare
m Moraines.
Scale 1:2,500,000 or 39·45 stat. miles·1 inch.
10 0 10 20 30 40 50

These volcanoes as a rule lie at the base of the mountain range, in comparatively low land, and as often as not slope down directly into the sea. They are all conical, though not so steep as those of Japan, and several have craters at their summits, as is proved by the cone being truncated. They are all of considerable height, and can be seen to cover large areas if reference is made to the charts.

Mount Erebus, 12,760 feet high, shows three marked stages in its growth—

(*a*) The lip of a huge crater, running round it as a girdle at a height of about 6000 feet above sea-level.

(*b*) A second lip, at an altitude of 10,000 feet, of a younger crater, from which streams of lava have welled up and flowed down its sides.

(*c*) The present small cone,* built up asymetrically inside the second lip, and from which the steam now issues.

Mount Terror, like Mount Erebus, is completely covered in snow, except in the more exposed spots, where either the wind blows the snow away, or the slope is exposed to the sun, which evaporates the snow as fast as it falls. This mountain is 10,884 feet high, and has a perfect crater rim at its summit, probably half a mile across; there are also occasional parasitic vents on the east side of Terror, but on the south and west sides the covering of ice and snow is so heavy that vents, if present, could not be distinguished.

Mount Discovery, like the two former, is thickly covered in snow on the south side, though on the north side it is practically bare. This mountain stands on an almost circular base, and is connected to the mainland on the west by a low dome (Mount Morning). This latter forms the right bank of the Koettlitz glacier, which flows out to the north into McMurdo bay, along the base of the Royal Society range.

Mount Melbourne, 8560 feet, the last of the volcanic cones which I will mention here, like the rest, is isolated, but lies more among the mountains than do the others, except, of course, Erebus and Terror, which form an island of themselves. It is rather steeper than the others, tapering up almost to a point, but, being truncated, probably has a crater at its summit a quarter of a mile in diameter. On the north side it rises sharply out of Wood bay—one of the largest indentations in the comparatively straight coast-line—while on the east it stretches out into a long promontory, namely, Cape Washington.

Before going further, I should like to put on record the great help I obtained from all my companions, and to say how I appreciate that help. It can at once be seen that it was impossible for me to have travelled over all the localities mentioned in this summary, and as it is impossible for me to name the source of my information in each case, I must refer my hearers to the charts and the sledge journeys for details on any particular point.

The Land Ice.

Contrary to expectation, the ice was found to be developed on a comparatively small scale,† and not, as was expected, covering the whole land surface, except for a few isolated peaks or nunataks.

The form of the land surface accounts for this to a great extent, for having an almost continuous cliff-face, on an average 10,000 feet high, facing the open sea, the amount of precipitation would have to be excessive to build up and fill in with ice the valleys at the base of the cliff-face.

It is true that in the vicinity of Cape Gauss, where the land is only 3000 or 4000 feet high, the features are similar to those of Greenland,‡ namely, a fringe of

* Scrope, 'Volcanoes,' sketch of Aetna, p. 190.

† A Geikie, 'Text-book of Geology,' p. 418; and Croll, 'Climate and Time.'

‡ Drygalski, 'Greenland Expedition,' p. 159.

land almost snow-covered, behind which lies an extensive area completely covered in snow and ice, or inland ice, as it has been termed. Further south, however, where the land rises to heights of 12,000 and 15,000 feet, typical glaciers occur, always on the east side of the mountain range, having their gathering ground or firn-fields among the higher peaks, and flowing out into the foothills through valleys.

It is remarkable that some of these glaciers do not reach the sea, but end 2 or 3 miles from it, and at altitudes of 2000 and 3000 feet above it.

On the west side of the summit of the range the land appears to fall away, and the whole becomes covered in snow; the bare mountains have their place quickly taken by isolated nunataks, and these are only found 5 or 6 miles to the westward of where the mountains properly end.

This inland ice finds its way to the sea through valleys which cut right through the mountain range, and the great ice-streams thus formed are usually of bare ice, for the winds that blow down them appear to sweep away any loose snow that may have fallen, and it is only near the terminal faces that any thickness of snow is found. On the other hand, the more protected glaciers in the mountain range, as a rule, have a significant snow-covering.

Running water was, as a rule, conspicuous by its absence, for it was only in the channels between the side of a glacier and a bare rock surface that any water could be seen, and then only in the two summer months proper, December and January.

All water that has been seen could be accounted for directly by melting alone, due to radiation from the sun, as all of it was due to surface thaw, and none to the internal heat of the glacier or the Earth's surface. After a summer snowfall, running water does take a small part in the cycle of seasonal change, for the snow falling on bare stony ground, such as Black and Brown islands, is quickly melted by the sun, and runs off to lower levels in a constantly increasing stream—so much so that large areas among the moraines at the base of Mount Discovery and Brown island are completely inundated.

Under this head, namely, The Land Ice, we must include the ice-sheets, of which there are at least three in South Victoria Land, namely, Ross' Great Ice-sheet or barrier, the ice-sheet in the vicinity of Cape Gauss, and, thirdly, the ice-sheet filling up Lady Newnes bay.

All these have as characteristics a horizontal upper surface of great extent, which may or may not be undulating (cf. the Humboldt glacier in Greenland); a seaward cliff or face of ice, almost absolutely perpendicular, and varying in height between 50 and 200 feet; and water at the base of this cliff, which is, without a doubt, deep enough to float the ice. For details, see the charts published in the *Geographical Journal*, August, 1904.

The Old Moraines.

Ice-scratched stones and doubtful erratic blocks were seen on the slopes of Mount Terror above Cape Crozier; but it was not until Dr. Wilson, following in the footsteps of Lieut. Royds overland to Cape Crozier from Winter Quarters, found what is probably an old moraine, high above the level of the Ross ice-sheet, and proved the ice-sheet to have been once higher than it is now.

There was other, though unsatisfactory, evidence of this greater height of the ice-sheet near the summit of White island and around Winter Quarters, but the old moraines above Cape Crozier put all doubts at rest.

Other old moraines occur in the channels between Black island, Brown island, and Mount Discovery, and as a rule hug the shore, as do ordinary lateral moraines.

And, again, on the top of Cape Adare erratics and old moraines occurred, which could not but have been formed by a greater extent of ice than obtains at present. Therefore the ice is near a minimum, which is rather a surprising conclusion to arrive at. I am not prepared to discuss the observations of others in North Polar regions, but would like to draw attention to such statements as—

1. Prof. Garwood's (*Q.J.G.S.*, vol. 55, November, 1899, p. 688), that the snow-line of Spitzbergen, in 78° N. lat., is at an altitude of 2000 feet above sea-level.

2. Von Drygalski's,* that the Greenland ice is receding, and it would require a warmer and more humid climate to extend the glaciers to their once greatest extension in his latitude, 72° N.

3. Dr. Schei's, that the ice of Grinnel Land is at a "maximum," and accompanies this statement with a photograph (*Geographical Journal*, July, 1901, p. 65), showing a moraine 50 feet at least above the level of the glacier. Dr. Schei's latitude north was very nearly our latitude south, namely, 77°.

All my evidence as regards the advance or retreat of the ice in South Victoria Land points the same way, namely, a retreat which is going on at the present day. This is exemplified again by the fact that the Ross ice-sheet, though moving 100 feet a month to the northward, has retreated on an average 15 miles during the last 65 years. These, and other points too numerous for this short paper, should be discussed in their relation to the Great Ice Age of Europe and the Great Glacier Period in New Zealand.†

The Sea Ice.

The sea ice that has been seen presented nothing of special interest in its formation or behaviour. McMurdo bay was guarded by a line of pack-ice from Cape Bird westward. When the *Discovery* entered the bay in February, 1902, this line had to be cut before the open water was reached, this open water not freezing over finally until May, although it had been practically frozen in April. The bay remained covered in a uniform sheet of ice until February, 1904, when a general break-up took place.

The ice as a rule does not attain a thickness greater than 8 feet by direct freezing, but where snow accumulates locally the thickness produced in a season may be as much as 40 feet. So also, locally, direct freezing will produce a thickness of 12 feet where the land prevents a rapid circulation of the water; and, on the contrary, where there is known to be a strong current, the ice, though freezing to a thickness of 8 feet during the winter, will be completely melted through during the summer.

The salinity of the sea-ice‡ is very variable, and seems to depend upon the rate of freezing more than upon the depth or distance from the upper surface. In many cases where the ice-floe was hummocked up, bands could be seen which were of different hardness as regards the action of wind and water. These bands all had different percentages of salt, and the thicker bands, which had been frozen quicker by a sudden fall in the external temperature, were found to contain more salt than the thinner bands.

Denudation.

Denudation, at the present day, on the whole plays a comparatively unimportant part in determining the features of the landscape. It is true that the Royal

* 'Greenland Expedition,' p. 33.

† Hutton, *Trans. N.Z. Inst.*, 5, 384.

‡ Axel Hamberg, *Bhang Till K. Svenska Vet.-Skad. Handlingar*, Band 21, Afd. II. No. 2, p. 5.

MORAINE ON WESTERN SHORE OF MCMURDO BAY.

A HOLLOWED GRANITE BLOCK.

Society range does show rounded rock surfaces due to the grinding of ice, or the rock matter carried along by ice, but in the vicinity of Winter Quarters none of this "ice-work" has been seen. The splitting off and cracking of large masses of rock due to the percolation of water, which expands on freezing, gives evidence of at present being the most important factor in the denudation of the land. Examples of this kind are well illustrated in Castle rock and the Cathedral rocks of the Royal Society range.

Water plays an unimportant part in some localities, while generally the work of running water of the present day is absent altogether. On the eastern side of Brown island there are several gullies cut out in the hillside by the water from the snow-fields flowing down to a lower level, and as water in any quantity has only been observed during two months of the year, its resultant effects are very marked.

Wind is an important factor in denudation, for both at Winter Quarters and in the mountains of the mainland its effects were observed. At the former locality some rocks were polished and pitted in the ordinary manner, but in the latter granite blocks were gnarled and hollowed * in a unique manner.

The surface around the harbour where the ship lay is composed of loose stones. Under them and mixed with them is the dust due to the disintegration of the rocks; and at some points a rock can be seen to crumble gradually until it becomes a mass of impalpable powder. This powder, however, cannot remain on the surface, and is, as a rule, protected from the wind by a covering of loose stones.

The Movement of the Ice.

There were few opportunities for measuring the movement of the ice, as there was no glacier within 20 miles of the ship, and the nearest glacier that could give any fundamental results was 40 miles away. When the ship first anchored, it was seen that the Ross ice-sheet exerted a certain pressure against the Winter Quarters peninsula, and the first party to Cape Crozier overland brought back tidings of huge ridges pressed up against the base of Mount Terror. However, a good measurement of the movement of the Ross ice-sheet over a long interval was obtained by a sledge party visiting Captain Scott's Depôt A, off the Minna Bluff, a year after it was laid down. The following brief results are inaccurate, as most have been obtained by hearsay, and have not been checked by angles yet; but they will serve the purpose here of showing how extremely slow the movement is, especially when compared with observations of others in the Arctic Regions:—

1. Blue glacier (Norwegian type), 1 inch per month.
2. Ice tongue in Erebus bay, 3½ feet per month.
3. Ferrar glacier (Greenland type), 5 feet per month, winter months; 12 feet per month in the warmest month, December.
4. Ross ice-sheet (Depôt A), 100 feet per month; overflow at Pram point, 8 feet per month.
5. Spitzbergen (Garwood), 800 feet per month.†
6. Karajak glacier (Drygalski), 1500 feet per month.‡

In conclusion, attention must be drawn to the action of ice as a "conservative agent."§ The ice-foot, which so many writers quote as carrying matter out to sea, we found to remain firmly fixed to the land, and to act as a "selvedge" edge does to a piece of cloth, *i.e.* strengthen it and retard wear and tear.

It may be remarked that the snowfall during the two years has not been

* F. F. Tuckett, *Geol. Mag.*, January, 1904.
† *Q.J.G.S.*, vol. 55, 1899, p. 686. ‡ 'Greenland Expedition,' Band. 1, p. 263.
§ Bonney, *Geo. Jour.*, 1893, pp. 481–499; *Proc. R.G.S.*, 1888.

excessive, nor has the climate been so severe * as previous explorers had led one to suppose. The climate may be described as perfectly dry (cold desert conditions), owing to the temperature of the air always being below the freezing-point of water, and this fact goes far to explain the present terrestrial features of South Victoria Land.

Before the papers by Lieut. Royds and Mr. Ferrar, the PRESIDENT said: It is necessary to bring the geographical results of the Antarctic Expedition before the Fellows of the Society in some form which will enable them thoroughly to understand the results and to discuss them, and after consideration I thought the best plan would be to request some of the officers of the scientific staff who were in charge of different departments of work to write short special papers on their own results, and then that the commander of the expedition should be requested, at a large general meeting, to review the whole subject, so that it might be fully discussed. Mr. Royds has kindly undertaken to give us some account of his work in meteorology. Mr. Ferrar will give us some account of the physical geography of that very remarkable range of mountains running nearly 700 miles north and south, and attaining heights of 1500 feet, and certainly not ending where they were last seen. Possibly at a future meeting we may have short papers from other officers. Mr. Armitage's work is, of course, of the greatest possible value, and is mainly connected with the magnetic observations at sea. Mr. Bernacchi has conducted most of the physical observations on land, the magnetic work, and the pendulum observations, with the assistance of Mr. Skelton; Mr. Barne, the tidal observations; and then we rather hope, also, to have short papers from Dr. Wilson on the geographical aspects and distribution of the aves fauna, and possibly a brief note from Mr. Hodgson with regard to a few of the invertebrates. This evening we shall have papers from Mr. Royds on the "Meteorology of the Part of the Antarctic Regions where the *Discovery* wintered," and Mr. Ferrar on the "Geology of the Antarctic Regions." I now call upon Mr. Royds to read his paper.

After the reading of the papers, the following discussion took place:—

Dr. BONNEY, in expressing his sense of the great value of the two papers to which they had just listened, said that in the *Geological Magazine* two accounts of hollow blocks, such as Mr. Ferrar had noticed, had recently appeared—the one describing a case in Corsica; the other, by Mr. Baron, in Madagascar. Both, in granite, were in localities where the action of wind in any form seemed not to be possible; and he did not feel satisfied with any explanation which had been offered, though at present he was unable to propose a better. He ventured to object to the use Mr. Ferrar had made of the term "esker," of which he had examined some good examples, including the noted one at Upsala. In them the stones were generally fairly rounded, and the materials more or less stratified. The photograph which had been shown them, he thought, represented a variety of moraine. These, however, were only trifling criticisms. Passing to the main points of the paper, he thought the most important was that the great ice-barrier, in all probability, did not rest on submerged land, but was afloat. That to him was quite a novel idea; but after listening to Mr. Ferrar's arguments, and as the result, he might add, of a conversation with Captain Scott that afternoon, he did not see how to dispute their conclusions. It was also very interesting to learn that, as had been clearly proved, the ice in the Antarctic had formerly been more extensive, and that a glacial epoch was not now at its maximum in that region. Mr. Ferrar was quite

* 'The Antarctic Manual.' R.G.S. 1901.

right in saying this observation was likely to be far-reaching. The relations noticed between the ice-sheet and the climate were also important. He had always felt difficulties in understanding how, with anything like the present configuration of Europe, that dry "steppe period," which occurred late in the glacial epoch of the north, could have been brought about. But Mr. Ferrar had shown that in the Antarctic something like steppe conditions now was the result of extreme cold, so that an increase of ice might not signify a fall, but a slight rise, of temperature. In other words, that, supposing the temperature to remain below a certain level, the amount of ice, as had been already observed, depended on the amount of precipitation, which, of course, meant the amount of evaporation somewhere else. Thus the smallest amount of snow might correspond with the time of most intense cold. These observations were also likely to be very important. He could only conclude by saying that he had been deeply interested in the paper, and hoped soon to see it in print.

Mr. TEALL: I am glad of the opportunity of saying how pleased I am to hear of these wonderful discoveries in the Antarctic Region. As a result of this expedition, the map has not only been modified and extended, but in the observations which Mr. Ferrar has made, in the collections which he has brought home, and in the striking photographs that Lieut. Skelton has taken, we have materials for forming some definite conclusions as to the geological history of the region. It is difficult to speak on this subject without a careful consideration of all the facts that have been ascertained; but I may, perhaps, allude to one or two points that strike me as being of great interest. We have heard of this important mountain range stretching for 600 miles or more from north to south, and containing some very high peaks. At first one might have expected that this range would prove to be of Alpine type with folded rocks, ridged up by lateral pressure; but instead of that, so far as I understand the matter, this high ground possesses a very simple geological structure; and, at any rate in the region examined, is made up largely of thick layers of nearly horizontal sandstone, containing plant remains, associated with great sheets of basalt. What these more or less horizontal rocks rest on is not quite clear at present, but Mr. Ferrar referred to gneisses and granites at a comparatively low level, and it is not improbable, therefore, that they represent the floor. At any rate, the essential feature of this important range is that it possesses a simple tabular structure. These horizontal rocks seem to end off—Mr. Ferrar will correct me if I am wrong—abruptly at the sea-margins. But they must have originally extended far away to the east over the flat ice traversed by Captain Scott in his memorable sledge journey. Is their absence in that area due to removal by denudation, or is it due to the fact that some great structural line runs north and south, along which the rocks on the east have sunk down to a lower level? Are we looking there at a great sunken area? Prof. Suess would probably take this view, and point to the volcanoes as further evidence of this conclusion. One other point. One cannot help being struck with the extraordinary evidences of change of climate. Mr. Ferrar said that rain-water is doing very little in that region now, but it must have played an important part in former times. More than 2000 feet of sandstone with well-rounded pebbles clearly indicate water-action on a gigantic scale, and climatic conditions very different from those which now exist. But there seem to be later evidences of water-action. It is impossible to look at the photographs which we have seen on the screen without coming to the conclusion that we are looking on surface features that have been sculptured by rain and rivers. In the nature of the rocks and in the topographical features, we therefore seem to have clear evidence of climatic conditions totally different from those which now exist.

Dr. SMITH WOODWARD: I will confine my remarks to a brief preliminary

statement concerning the fossil plants. The carbonaceous matter found by Mr. Ferrar is really of great importance, because I think I am right in saying that this discovery was made at a spot no less than 500 miles south of the fossil plants that were brought back by the Swedish Expedition. The Swedes, of course, were able to obtain some satisfactory specimens for determination, but I regret to say that it is quite impossible to make out the new material before us brought by Mr. Ferrar. All who have seen it are quite agreed that this carbonaceous matter must be due to vegetation, but it shows no structure whatever. It has neither surface structure nor microscopic structure, and it seems impossible to determine whether it is due to land vegetation or to marine vegetation. Dr. Scott, of Kew, and Mr. Seward and Mr. Arber, of Cambridge, have kindly examined the material with great care, but no specimens that have yet been studied show any structure. Although, therefore, there is no doubt that Mr. Ferrar has discovered vegetable remains in the sedimentary rocks of the extreme far south, we are unable to determine what they are; nor are we able to make out from these fossils the age of that great sandstone formation of which we should like to know so much.

Mr. Bernacchi: I have a few remarks to make with regard to that fascinating problem—the great ice-barrier. I should like to ask Mr. Ferrar how he accounts for the ice-barrier being afloat. It seems inconceivable to me that anything but the extreme sea-edge of such a vast body of ice should be floating. Near Cape Gauss, some miles to the north of our winter quarters, there is a fairly large body of ice extending for some considerable distance seawards, and presenting in many respects the appearance of the great Ross ice-sheet; it terminates seawards in perpendicular cliffs; the soundings along the edge are approximately the same as along the great ice-barrier, and the surface is comparatively level. Now, it is evident that this ice is land ice flowing through the valleys in the comparatively low land, and spreading out and extending seawards until it reaches water sufficiently deep to float it, when it breaks off and drifts away in the form of icebergs. To my mind the great Ross ice-sheet is formed in very much the same way; it is possibly the accumulated ice-flow of centuries over a comparatively shallow ocean, breaking away continually from its seaward edge, and continually renewed from those huge valleys or gaps seen by Captain Scott in his southern journey, possibly not only from this land, but from land that is found farther south, and takes a trend eastward. I do not know that I have anything more to say, except to ask Mr. Ferrar how he accounts for the ice-sheet being afloat.

Prof. Garwood: So many interesting points, as previous speakers have said, have been brought forward that I do not know which to select. There are one or two questions I should like to ask. One is the question of raised beaches. I do not think Mr. Ferrar said whether there were any raised beaches, and I think it would be very interesting to know whether there are. Another point was with regard to those escas, which, I quite agree with Prof. Bonney, look more like ordinary moraines. Then there was another point with regard to the floating ice, that was whether they came across any flat stones connected with these icebergs. I was very interested when I was at Spitzbergen to notice a large number of stones collected there which only had one flat polished side; and I was interested, on looking at some of the specimens brought from Franz Josef Land, to find a similar feature on those stones. I should be very glad to know whether Mr. Ferrar did notice that feature, because it seems to me it is possible in certain cases to use that as evidence of floating ice. If you find the greater number of stones have only one flat side, it would seem to point towards the action of floating ice, because, obviously, a stone frozen into a solid mass would not be turned round when brought into contact with other objects in the same way as they are in glaciers,

so that only one side would be scratched and polished. With regard to the rate of advance of the ice, certainly it is very striking to note the very slow rate at which this huge ice-sheet is advancing compared with things far north. The other point is with regard to the decrease of the ice. I must say myself I have always been struck with the great difficulty of accepting that theory. Gregory and others have called our attention to the effect of moraines; they are very much lower than the regions at the present day. This same effect coming up again in the Antarctic is a very interesting feature. Well, I won't occupy your time any further, but will express my extreme interest in the work of the expedition.

Mr. Lamplugh: There is so much that a glacialist would like to ask on this paper, that at this hour it would probably be best to say nothing. But I cannot refrain from asking just one question—whether the peculiar long straight valley holding a glacier, which we saw in the photograph, has been worn by ice? There is much discussion among geologists as to the erosive power of ice. We seem here to have a waterless land where ice is decaying away, and beneath the ice-sheet we find a great valley of the type that is usually regarded as water-worn. Perhaps Mr. Ferrar will say whether he considers that the ice pouring down the valley has produced the hollow, or whether the feature is supposed to be older than the ice-sheet. This is only one of the many points on which we shall sooner or later ask the investigators to help us in our efforts to understand the conditions which formerly prevailed in our own country.

Mr. Ferrar: I should like to answer Mr. Lamplugh first. That glacier I take to be in a fault valley. Dr. Teall touched on the faults in that region forming the great seaward edge of Victoria Land. If we regard Victoria Land as the original surface, and the Ross sea the downthrow side of the fault, then the coast will be in the fault-plane, with the volcanoes along it. There are many valleys that are similar to that one which appear to be fault-valleys, and run out parallel to one another, but are uncharted, as they have not been traversed. The positions of the rocks in the same sequence on both sides of the valley being at different levels, the steps in the Thalweg and the "capping basalt," faulted down perhaps 2000 feet below the plateau-level, lead to the same conclusion.

I should like to thank Dr. Bonney for telling me of other records of rocks being worn in this peculiar way. The term "esker" I used because it was unfortunately applied by us as a local name, and used as such for convenience only. The cones are only moraines, as Prof. Garwood pointed out, but they lie transversely to the drainage lines. I saw no evidence of raised beaches. It is true, away south, 20 miles from the edge of the sea, and on floating ice which is undoubtedly glacier-ice, we found Balanus shells, but these were amongst morainic cones of ice-scratched stones, and near these cones were several bosses, or mounds, 2 and 3 feet high, of a white crystalline salt (sodium sulphate?). Above Cape Crozier there were certain horizontal ridges of loose material, and on them were granite and quartzite boulders. These ridges I took to be moraines, and this view is further strengthened by Dr. Wilson's observations on the east side, where he found those long horizontal moraines running round the slope of Mount Terror above the great ice-sheet. With regard to ice-scratched stones, in answer to Prof. Garwood's question, I did not examine fragments dredged up with that particular point in view, but there are at the Natural History Museum some hundreds, which may give evidence as to whether stones carried by floating ice are scratched more on one side than on another. I did not attach much importance to the latitude in which the several fossil plants have been found, so long as they occurred south of the circumpolar ocean, but if a few miles is of any importance, I might be allowed to point out

that the *Discovery*'s fossil plants were found, nearly twice as far south as Dr. Smith Woodward mentioned, namely, over 800 miles, and at a distance of 2500 miles from those of the Swedish expedition, as well as on the opposite side of the pole. I beg to be excused for mentioning this, but I find the Antarctic Regions are regarded relatively, distances being judged according to the size of the map, and that the great spaces separating the international stations are too frequently overlooked.

As regards the *barrier* being afloat, I think its horizontal upper surface is practically enough to prove its being borne by water. It may, of course, touch or adhere to the land locally, but in the main there is no other condition that could give it this horizontality. Again, the *tide crack* is never absent, wherever it may be looked for. Dr. Wilson found it in the most impossible places when on a sledge journey towards Cape Crozier, and on sledge journeys in other directions. This *tide-crack* is never absent; even on King Edward VII. Land there is evidence of a differential movement between the ice-sheet proper and ice supported undoubtedly by land. Those are some of my reasons for thinking the Ross ice-sheet is afloat.

The PRESIDENT: I should like to ask Dr. Smith Woodward in what way these vegetable fossils have been injured.

Dr. SMITH WOODWARD: I think they have been destroyed by decay. It generally happens that when fossil plants are buried they decay and become carbonized, and most probably these have not only decayed since they were in the rock, but were destroyed in part by drifting and mixing together before they were buried. They look very much like drift vegetation, but owing to the carbonization we can see nothing whatever with the microscope.

The PRESIDENT: I think the two papers * we have listened to, and the interesting discussion that has followed, is the beginning of the garnering of our harvest of results to which we may look forward. The meeting, especially Members of Council who are present, will be interested, I think, to hear that I had a cheque for £10,000 put into my hands this afternoon, which is very much less than the *Discovery* was worth; but, at the same time, it will enable the joint finance committee of the two Societies to bring out all the publications and enable all the work to be done in a most liberal spirit. We must thank these two officers, Mr. Ferrar and Lieut. Royds, for their very interesting communications, and we must all remember with what great difficulties and hardships they had to contend in taking their observations and obtaining these results. Lieut. Royds made a most important and a most difficult journey over the barrier with Mr. Bernacchi, and I think Captain Scott told me that Mr. Ferrar with five others made, next to himself, the longest sledge journey—dragging the sledge—that has ever been made either in the Arctic or Antarctic regions. I think Captain Scott went over 32 miles, and Mr. Ferrar went over 33 miles, in one day. So I think we should be grateful to the two young explorers for the diligence and resolution they showed in obtaining these results. I now beg to propose, in closing the meeting, a hearty vote of thanks to Lieut. Royds and Mr. Ferrar.

---

* Lieut. Royd's paper was read at the same meeting.

III. ON THE METEOROLOGY OF THE PART OF THE ANTARCTIC REGIONS WHERE THE "DISCOVERY" WINTERED.

By Lieut. C. W. ROYDS, R.N.

The physical geography of a region is affected in various ways by the meteorological conditions. I had charge of the meteorology during the three years that the *Discovery* was absent from England, including the two years and two months that she was within the Antarctic circle. I have, therefore, been told off to submit a paper on the meteorology of that part of the Antarctic Regions where we wintered, with special reference to its physical geography. I have endeavoured to fulfill this task to the best of my ability, but I am impressed with my incompetence to undertake it.

I need not describe in any detail, the route of the ship during the navigable season of 1901 to 1902, as that has already been done by more competent hands. I need only remind my audience that we passed down the eastern coast of Victoria Land, from Cape Adare to Cape Crozier, examined closely the face of the great ice-barrier throughout its entire length, and discovered high land to the eastward.

Throughout the passage down the coast we experienced more or less light south-easterly winds, except for a very heavy gale from the south-west off Coulman island, which lasted for three days. The winds we experienced whilst passing along the barrier were from the south-east to south-west with few exceptions, and very cold winds they were, as they had passed over the many hundreds of miles of barrier to the southward before reaching us.

It is necessary that I should describe more fully the position of our winter quarters, especially with reference to the amount of shelter caused by surrounding land. The ship was in a small bay of about a quarter of a mile in depth. All round, from north-north-west through east to south-east, there was land rising quickly to some height. In the north-north-west the hills were 400 feet high, and these extended to north-east, and then a hill of 1000 feet in the east, and one of 700 feet in the south-east. Between the east and south-east was a deep gulley, or gap as we call it, which opened out on to the ice-barrier. From south-east through south and west to north-west we were entirely open except for land 20 to 50 miles away. From north-west back to south-west was the Albert range, rising to peaks of 15,000 feet, and to the south were some islands 3000 feet and land rising to 8000 feet.

In our bay there was a very pronounced local wind, namely from an easterly direction, and it was no uncommon thing for one to leave the ship, blowing a fresh gale, and, having walked a mile to the south and rounded Cape Armitage, find it a dead calm. Very many instances of this might be quoted, only time will not permit.

Before proceeding further, I should like to say that any temperatures or barometric readings that are mentioned are entirely uncorrected, and in the case of the means they are not issued as correct from the Meteorological Office, and are only the results as worked out during the time we were in the south. In every case the temperatures are Fahrenheit, and the winds are true.

In speaking first of the temperatures, there is very little to say, on account of the observations not being worked out. The coldest temperature registered at the screen was $-59°{\cdot}5$ on August 20 of our second year, our first year's minimum being $-50°{\cdot}5$ in the same month of August. The corresponding maxima for the two years were $+39°$ in 1902 and $+42°$ in 1903, curiously enough on the same day each year—December 26.

It was unfortunate that, on account of the ship being left with so few hands from November, 1903, to February, 1904, night observations had to be discontinued, and so I am unable to compare the monthly means of the two years. This will be done; as, although we have not the eye-observations for those few months, we have the records of the self-recording instruments the whole of our stay in those regions. At one time I thought of trying to compare our temperatures with observations of other expeditions, but on looking into it, I decided that they were not comparable, except in the case of the Cape Adare observations. All the remainder were movable stations, and were taken at sea, whilst ours and the Cape Adare ones were fixed land stations.

In comparing the first year's means with those of Cape Adare, one finds that the difference is roughly about 7° lower at our station. Two things can account for this—latitude and locality, as the close proximity of that huge mass of ice of the barrier to our station must necessarily reduce the temperatures. There is one marked similarity between the two stations, and that is the extraordinary rise of the mean for July. I account for it by the very long duration of southerly gales we experienced, during which the temperatures invariably rose to above zero. At Cape Adare, also, July was their stormiest month. In our second year, on the contrary, July was our coldest mean, and we had a comparatively calm month, the percentage of calms being the highest for the whole time we were south, namely, 34·1 per cent. In comparing the temperatures for the two years, you will notice that the second is considerably colder, and one can reason it out to some extent by the fact that there was more ice in the vicinity, and that ice was thicker than in the first year.

Whilst on the subject of temperatures, I might speak about a minimum thermometer we placed on a stand 1½ miles from the ship to the south, and well clear of all land. The difference between the readings of this thermometer and the one in the screen was extraordinary, especially in calm weather, 10°, 15°, and even 20° being a common difference. For instance, on August 10, 1902, the temperature at the screen was −35°, with light easterly airs, that at Cape Armitage being −50°. Again, on the day that we recorded our lowest temperature of −59°·5 at the screen, the corresponding minimum at Cape Armitage was −64°·6; the lowest reading at Cape Armitage was −67°·7, or nearly −100° of frost on May 16, 1903. Whether the fact of our screen being more or less surrounded by high land made that difference alone, I wouldn't like to say.

In referring to the spring journeys, I can only say that if any one seriously wants to know what real discomfort is, coupled with extreme cold, let that person go on a sledge journey, leaving the ship early in September, and I think he will agree with me that it is the acme of discomfort, and will not remain out a day longer than he can help. With regard to the barometer, I have very little to say, with the exception that, as in former expeditions, we found the pressure to be low. As a means of warning for the gales, it was not of much value, but very often showed the approach of a cold snap by falling generally. There is rather a peculiar thing that has happened to all the barometers. On comparing them with the standard at Kew, it is found that they have all increased their corrections. Whether the temperature has affected the glass or cistern to a permanent degree is not certain, but the fact remains as stated, that the corrections are all larger.

The direction of the winds is my next subject for discussion. Our prevailing wind was from an east to south-east direction. There is very little doubt but that the winds are the worst part of those regions. The question to be answered is whether the common condition down there is windy with intervening calms, or whether, on the other hand, the calm conditions prevail, broken by strong

winds. This can only be solved by the working out of the numerous observations, summarizing the whole of the work done down there; and personally I should be inclined to say that the windy condition prevails, and life made possible by the calms. Without having compared the two years' observations, I should say that our first year was infinitely more boisterous than the second; but whether or not this will be the case when the work is completed, I shouldn't like to say. I spoke earlier about the local winds, and I cannot help mentioning them again, as they were so marked, and noticed by every one on board.

Throughout the whole of our stay in winter quarters, we recorded no wind from the west or north-west, except occasional light airs. Winds from the north were more common in the summer, and especially during our last one. Gales from the south-east were generally accompanied by low temperatures, and on more than one occasion the temperatures have been below $-40°$, with a wind force of 7 to 8 blowing, making life outside the ship far from nice. But the worst gales were from the south and south-west, and we used to call them blizzards, as they were invariably accompanied by absolutely blinding drift snow. It is really a very difficult thing to any one who has not experienced a gale of this description to know what happens.

The air is entirely filled with driving snow, which strikes you just like a sand-blast. You cannot face it, but have to stumble on to wherever you may be going with your head down and arms protecting your face; and even could you face it, you are not able to see a yard all round you. I will give you an instance of how blinding they are. Whilst preparing for the winter after our arrival in the bay, and after the sea had frozen over, posts connected with ropes were led to every place where it was necessary to go every day—that is, to the magnetic huts and living hut, and to the meteorological screen.

It was during the latter part of the first winter that what might have been a serious affair happened. You may have heard that we had at times concerts, theatricals, and at one time a nigger troupe, to liven things up. Now, it was no good rehearsing these things in the ship, as every one would know exactly what was going to be done, and the jokes to be made, consequently it meant the performers going over to the living hut for the rehearsals, and as in this palace of varieties there was invariably a temperature of $-20°$ and below during the time we were rehearsing, it was no great pleasure playing the piano. It was on one of these occasions that I had taken the party across to the hut to rehearse the nigger troupe, and it was blowing a hard blizzard, with exceedingly low temperatures. On arrival at the hut, we found two officers, Mr. Skelton and Mr. Bernacchi, taking pendulum observations, but they left before we started our rehearsal. We finished in about an hour and a half, and then started back to the ship. As usual, one cautioned the men to keep together, and not let go the rope which led back to the ship. We had got about halfway across, the whole distance being only about 200 yards, when I heard a shout, and knew that, as it was none of my party, some one must be adrift from the ship. We opened out, and found Mr. Skelton and Mr. Bernacchi, who were quite lost, and who had been wandering about for an hour and a half, unable to find out their whereabouts. Both were more or less frost-bitten about the face, and were exceedingly glad to have been found.

One could quote many instances of the like nature, all pointing out how absolutely helpless one is in a blizzard, unless you know exactly where you are. During these blizzards the ship gets more or less buried, and everything else besides. After one or two of these, it is always necessary to lift and move the meteorological screen, as it is invariably buried. You can imagine how impossible it is to measure the snowfall under these conditions. In fact, to tell the truth, it

is always a matter of some surprise when, after the blizzard was over, one was even able to find the snow-gauge, which was completely buried under as much as 3 and 4 feet of snow.

The great peculiarity of these blizzards was the invariable rise of temperature. They always came from the south and south-west, and once the wind got back to the south-east or east the temperature always fell again. Great fluctuations in the thermograph curve always gave us some warning of an approaching blizzard. A glance at the map will show you that these south-west gales came over high land, which would cause more probably this effect, rather than the idea that they come over open water. I am unable, I am sorry to say, to speak intelligently on this subject, and will leave it to others for solution; but this I would like to say, that I have always understood that the Föhn wind is a dry wind. I may be wrong in my supposition, but our south-west winds always brought drift snow with them, and I should say that they also brought snow along with them. Our heaviest gale was on July 19, 1902, between the hours of 4 p.m. and 8 p.m. of the next day. From 10 p.m. to 10 a.m. the Robinson's anemometer gave an hourly velocity of 85 miles. By the latter part of the gale the temperature had risen to $+15°$, although it had been below $-20°$ the day before, and dropped again immediately the wind went to the east. We never got a minus maximum temperature for the month, purely by reason of these blizzards bringing the high temperatures.

To get caught in one of these gales on a sledge journey was no joke, and, speaking personally, my party was five days in a tent unable to do a thing. At another time in the same spot, Dr. Wilson was for nine days weather-bound, and, in fact, it was an uncommon thing for a party away sledging not to be laid up for one or more days. The winds experienced by the parties away sledging are very interesting. Throughout the captain's southern journey, he experienced southerly and south-westerly winds. When on the inland ice-plateau, 9000 feet above the sea-level, he recorded continuous west-south-west winds, whilst at the same time, whilst on my journey to the south-east on the barrier, we got perpetual south-west winds, and all the sastrugi—those are the snow-ridges caused by the wind—pointed to south-west, and to all appearances it is the prevailing wind. At the ship during this time they recorded continuous strong winds, but more or less from an easterly direction. Our second year's sledging season was considerably worse for sledging conditions than our first, and all the parties, on their return, complained of incessant winds, which delay a sledge-party dreadfully. It was at Cape Crozier that a party always got strong gales. Across the bay between Cape Armitage and Terror point, a strong wind was never felt; neither is there any indication of anything stronger than light airs.

I have been talking all the time about the surface currents, except in the case of the western journey, and now I will just say a word or two about the upper currents. We were very fortunate in having such a splendid indicator of the upper currents so close to us as we had in the smoke of Mount Erebus, the only pity being that it was not visible from the ship, but one had to walk out about 300 yards or so before we got it in view. Whenever any one went for a walk or was in sight of the mountain, they always, on their return, reported which way the smoke was going. The usual direction was to the north-east, pointing to an upper south-westerly current, and similar to the winds experienced by Captain Scott on the inland ice. We invariably expected wind if we saw the smoke going to the north-west, and were seldom disappointed. It was a most common thing to see the smoke going north-east at the same time you, on the level, were in a strong easterly wind, and I have noticed detached clouds, only about 2000 feet below the summit, passing quickly to the west, while the smoke was going in a steady stream to the north-east.

With regard to the precipitation, as I have remarked before, it was impossible to determine it during the blizzards. Throughout the winter months very little snow falls; but during the summer months we had very heavy falls of snow, sometimes small dry flakes, and at other times the more common English snow-flakes, damp and wet. At times there was considerable precipitation during clear weather of most beautiful ice-crystals, and whilst sledging the effects of the sun on these crystals was most dazzling. Throughout our stay inside the Antarctic circle we recorded no rain; only on one or two occasions did we get any large accumulation of fog-crystals so common on Ben Nevis. I might mention that fogs are not nearly so prevalent as is supposed, unless we were lucky in not meeting them. The amount of sunshine down there is a great deal more than we had been led to expect, and in the summer we used to get day after day of most glorious sunshine day and night.

Of other phenomena the mirage is the most common, and at times is very considerable. Haloes and coronæ are also very common, and we have seen some very beautiful and complicated effects from the former.

I trust that these few notes on our meteorology, necessarily made under disadvantages owing to our results not having yet been worked out, will be of some use. I think they may give a sufficiently clear general idea of the conditions for considering the relations between the meteorological phenomena and the physical geography of the region.

After the paper, Mr. SHAW said: The information that the meteorologists of the expedition have brought back is exceedingly interesting from many points of view. One point interests me particularly, because it confirms an idea which I had in my mind in the early summer before the expedition came back; it is the difference of the direction of the smoke of Mount Erebus from the direction of the wind at the surface. I had come to the conclusion that it was probable that the arrangement of affairs towards the south pole was a cold layer of air at the surface—about that one was sufficiently certain—and above that a layer of upper air moving independently of the lower air; and that, whereas the surface layer would probably circulate, taking the average for the year, from east to west, so that the surface wind would probably be an easterly wind, the upper air would, on the other hand, circulate in the opposite direction round the pole, so that the winds to be expected in the upper regions would be westerly winds.* One of the great good fortunes of this expedition, from a meteorological point of view, is that their winter quarters were close to Mount Erebus, and that they could see the smoke by going not further than 300 yards. It does appear that the general drift of the smoke was towards the east, whereas the wind on the surface was, generally speaking, from the east, showing a circulation in the opposite direction. That is a matter of very considerable importance to the general theory of meteorological currents. There is another point with reference to the surface winds which raises a question of interest, though I am afraid we shall be unable to solve it. It concerns the actual observed directions of the surface winds from day to day. If you consider the condition of affairs in the southern regions you will notice that they are entirely different from the condition of affairs that we have in temperate regions. I am speaking of the winter time, the most interesting time there. Here the dominant agent which causes local disturbances in the general meteorological distribution is, of course, the sun, and it is extremely powerful. There, the sun being absent, the dominant agent is the radiation to the clear sky. In our region, if the sun shines

* See *Proc. Roy. Soc.*, vol. 74, p. 28. 1904.

upon the ground it warms the air, which goes upwards and disappears; there, when the air near the surface is cooled by rapid radiation to the sky, the cold air so produced does not go away as our warm air does; it remains on the surface, and flows down like a river. The consequence is that over the whole Antarctic continent in winter you must necessarily have something that corresponds to enormous rivers of cold air flowing downwards towards the sea. How far that radiation and the consequent rivers of cold air flowing over the land affect the general meteorological conditions is again a matter of very great interest. That question, I am afraid, we shall hardly have information enough to answer. There is, besides this simple effect of radiation, the effect which the enormous height of land close to the region has in exaggerating the effects originally due to radiation. Lieut. Royds was perfectly right in assuming that a föhn wind is a dry wind. But I am not sure he is correct in assuming that, because the wind in the Antarctic carries snow, it is therefore necessarily a wet wind. Perhaps he has made experiments in that direction. Wind in those regions may carry snow with it without being necessarily a very moist wind. As a matter of fact, the amount of moisture that can be contained in air at those low temperatures is extremely small, and if a specimen of air has snow with it, it is rather a matter of curiosity to inquire where it got it from. The determination of that question would help the solution of the question whether the wind was a föhn wind. I congratulate the expedition and the Society most warmly on the contributions that they have made, and Lieut. Royds in particular for the interesting paper he has given us.

IV. THE DISTRIBUTION OF ANTARCTIC SEALS AND BIRDS.*

By Dr. EDWARD A. WILSON.

THE only mammals in the Antarctic Regions are seals and whales, and the marine life on which they live is abundant. There are, in consequence, no less than five different species of Antarctic seal, and at least as many as six different forms of whale and dolphin. Some of them occur in very considerable numbers.

Taking first the seals, the most notable point about them is that, although they form a very distinct group amongst themselves, and are distinct, *as* a group, from the seals of all the world, yet they each have a dentition which is so different from the other, that they have been considered worthy of separate generic names. The three seals which are most typically Antarctic have a very definite distribution. The first to be met with by every ship as it enters the pack-ice is the White seal, called Crab-eater—I know not why, because it never seems to eat a crab. It is the only seal that is common in the pack, and it lives there, as we know from M. Racovitza, of the *Belgica*, throughout the winter months as well as in the summer. It is met with rarely on the coast of South Victoria Land; and in McMurdo strait, whereas we saw many thousands of the Weddell seal, I do not think we saw half a dozen of the White. But in the pack-ice they are fairly common, lying out on the floes in little knots of from two to six or eight. This is the seal that appears to suffer more than any other from the attacks of Killer whales, which hunt in herds all round the edges of the ice, and leave the marks of their teeth in the skin of nearly every full-grown seal. The scars on southern seals are of two types. First, we have the long parallel rents that, as I say, are made by the teeth of the Killer whale; and these are almost invariably on the

* This and the two following papers were read at a meeting of the Research Department on February 20, 1905.

lower half of the sides and abdomen, as though the attack had been made from underneath. Then there are to be seen in the males an enormous number of shorter and smaller scars, often covering the entire body in the Weddell seal, but chiefly on the head and shoulders in the rest, and these are due to the fights that the bulls engage in amongst themselves. I have described the scars chiefly in connection with the White seal, but they are often present in the other species too.

The Ross seal is the least common of the southern seals, and we were lucky in obtaining three, while the *Morning* in her passage through the pack obtained three more. The Ross seal has been known particularly for its vocal powers, which were well described by M. Racovitza; but I think that in the Weddell we have a songster that we might pit against the Ross. This seal's power of vocalization is most remarkable, and the following is an abstract from my journal, describing an example of it: "He treated us first to the long and musical moan, which is so like the moaning of the ice, only begins high-pitched and ends up low. This was quickly followed by a series of grunts and gurgles, rather like a guinea-pig; and then began a series of plaintive piping notes, which ended up exactly on the call-note of a bullfinch, this changing to a long shrill whistle and a snort, as though he had held his breath for the exhibition much too long."

The Weddell seal is the one we saw most often, and practically lived on for a year and a half. The flesh is dark and coarse, but not always tough. The blubber alone is rank, and must be carefully dissected off the joint. The liver is most delicious. The Weddell, unlike the others, is a shore-going seal, and is seldom seen in the pack of the open sea away from land. We had large numbers of them with us all the summer, and during the winter they were only less in evidence because they lived and slept chiefly in the water. They are very slow and sluggish on the ice, but in the water as rapid as a fish.

Two seals I have not yet mentioned—the Sea-leopard and the Sea-elephant. The Sea-leopard is a great wanderer, and is known as well from Australia, New Zealand, and the Southern Ocean islands as from the Antarctic ice. He preys on the penguins, and in the stomach of one we found the skin of a well-grown Emperor. It seems he may be met with anywhere in the south, and he is not limited, as are the other three, to the ice.

The last of the seals on the Antarctic list is the one which the recent British Expedition added. The skin and the skull are at present in the hands of the taxidermist, but I think it will prove to be a wanderer from the Southern Ocean islands, representing the now rare Sea-elephant of the M'Quaries. It was a young male, about half-grown, and measured 11 feet round, and 12 feet from nose to tail.

This, then, is a very short account of the five Antarctic seals, and only three of them are strictly ice inhabitants. The Ross, the White seal, and the Weddell are true Antarctic forms; for although a stray example of the Weddell was recorded from Kerguelen island by the *Challenger* Expedition, I include him as a true Antarctic seal. I think the single occurrence of the Sea-elephant in McMurdo strait was as purely accidental as the occurrence of a Weddell in Kerguelen island.

The food that each of these seals lives on differs. The Crab-eater feeds on shrimp-like crustaceans, and his teeth are lobed to form a kind of sieve through which he squirts out water and retains his food. The Ross has finely pointed re-curved teeth, with which he holds the squids and cuttlefish that apparently form his food. The Weddell lives on shallow-water fish, and the Sea-leopard on penguins. The Sea-elephant had apparently lived on nothing when we killed him; but in the M'Quarie islands he would have lived on molluscs, which he finds among the kelp.

It is noteworthy that all these seals are what are known as earless seals, and hair seals, as opposed to eared seals, which may be fur or hair-bearing. The sea-

lions and sea-bears of the sub-Antarctic area have never been recorded from the ice. Sea-lions, which we saw in abundance at the Aucklands, are hair-seals, with a small external ear. Sea-bears—which occur also at the Aucklands, but were recently almost extinct, and are now most carefully preserved—are fur-bearing seals, with a small external ear. Both Sea-lions and Sea-bears still use their hind limbs for progression on land; but none of the Antarctic seals do this, nor have any of them an external ear, nor have they anything more like proper fur than has the horse.

The commercial value of the skins of the southern seals is very small. They make good leather, and now that hair-seals are being used for motor coats, their value may go up; but so far the Antarctic seal-fishery has never met with much success. The abundance of the Killer whale in the south must always have a depreciating effect on the value of these skins, for hardly one in eight or ten is free from the most unsightly scars. The Weddell seal, which has learned to avoid migration, and remains far south throughout the year, is the least affected by them, and as his coat is the most handsomely marked of all, it is possible he may yet be wanted by the sealers. He lives, however, in secluded bights and bays and straits, where the ice is always late in breaking up; and this, I think, would always be his main defence, for ships could not get at him till the end of the navigable season. In these secluded bays the Weddells collect in the spring, and in October and November the young are born, in a woolly coat, which they begin to throw off in fourteen days. At the end of a month it is all gone, and the young one then follows its mother into the water, and soon becomes independent.

I must not give more time now to the seals, but go on to say a word or two about the whales and dolphins.

We have very little that is new. We saw at least six different species, two or three of which have never been killed or captured, and so are without a name. One of these is a black whale of medium size, with a very high sword-shaped dorsal fin. We saw two herds of them amongst the ice in Ross sea, and Sir James Ross describes what must have been the same whale as having been seen in the same locality. There is also a very strikingly marked dolphin, which we saw round the ship on each occasion as we made our way southward through the pack. It must be a species closely allied to the Dusky dolphin, but has the rich brown and white arranged in a different manner; and whereas the Dusky dolphin is common just north of the limit of pack-ice, the species I now mention as undescribed was seen only after entering the pack. In a ship such as the *Discovery*, with so many other important interests, it was quite impossible to turn "whaler." But there is a field of work in the south in this direction which would well repay a summer cruise or two.

Sir James Ross spoke much of the Right whales he had seen in Ross sea, and what he said of their abundance led a number of whaling captains to go and look for them. But they were disappointed, for they saw not one. And much has been said since then of the possibility of a mistake having been made between the Rorquals, which are common there, and the finless Right whales, of which we saw none at all. I believe myself that the true explanation is to be found in the wasteful methods employed in Right-whale fishing in the south, where watch was kept on shore for the approach of cow-whales with their calves, and where first the calves were killed to make certain of the cows. Whaling on these lines must rapidly produce extermination. As bearing, however, on the possibility of mistake in the identification of whales at a distance, I remember once, with Lieut. Royds, watching what for a time we thought were Right whales. They were constantly appearing, evidently large whales, and with apparently no back fin, till at last we saw one separate from the rest, which came to the surface again and again, and never showed a fin till he made his final plunge, and then the hinder third of his

EMPEROR PENGUIN ROOKERY.

ADÉLIE PENGUINS.

back appeared, and showed us that he really was a Rorqual, with a dorsal fin. But I believe that whalers judge far more by the spout of a whale than by the absence or presence of a fin, and the spout of a Right whale is said to be unmistakable.

I must now leave the subject of whales, which, however full of interest, is an unprofitable one to argue from, because so little is known of them with accuracy.

In turning to the distribution of southern birds, one may first notice that some are limited to the ice, and others have a far more extensive distribution.

The Emperor and the Adélie penguins are strictly ice-birds, as are also the Snow petrel and McCormick's skua. The Antarctic petrel migrates northward in the winter, and frequents the ice within the Antarctic circle in the summer, though where it breeds is still a mystery. Then, again, the Wilson's petrel breeds in the southernmost regions, but wanders the whole world over at other times. The Giant petrel and the Southern Fulmar, Cape pigeons, certain Albatrosses, a Tern or two, and several of the Whale-birds, form yet another class which breeds in the sub-Antarctic area, and yet may constantly be seen in summer in the ice.

The whole question of the geographical distribution of the birds seen in the south is, therefore, somewhat complicated.

The Emperor penguin is the most truly Antarctic bird of all. It keeps as far as possible, not merely to the limits of ice, but to the southern border of the floating ice, or the northern edge of what is fast.

The Adélie, on the other hand, goes south to breed, but as the winter night comes on migrates to the northern edges of the pack. To the Emperor the pack-ice is a school and convalescent home, where the young are sent to change their first year's plumage, and the old ones go to moult and rest awhile from the fatigues of incubation, which, strange to say, in their case occupies the greater part of the Antarctic winter. The Snow petrel must be classed with the Adélie penguin, as it is never seen so far south as the Emperor in winter. Both the Adélie penguin, however, and the Snow petrel keep strictly to the ice, and Sir James Ross was right in looking upon the latter as an invariable sign of its proximity.

Not so the Antarctic petrel and the Fulmar, both of which are abundant in the southern oceans away from ice and out of sight of bergs in winter.

McCormick's skua we never saw away from ice, and being a shore-frequenting bird for the most part, there is a wide stretch of ocean separating him from his very close relative, the larger and darker and more northern form, the Antarctic skua. The names of these two birds are most misleading. A good deal of new light will be thrown on the distinction of these hitherto somewhat doubtful species; they will prove, I think, to be rather more distinct than they have sometimes been considered, so that their geographical distribution, as is also the case with the King and the Emperor penguins, becomes of more significance. In the case of these two penguins I remember a discussion, before the Emperor's chickens had been seen, in which it was held that the Emperor was merely a localized variety of the sub-Antarctic King. If so, the chickens would be hardly separable. But when the Emperor's chick appeared, instead of being uniformly dark and brown, he happened to be white, and so we have to consider the King and Emperor penguins as more distinct than ever.

There is a very parallel case in the two large albatrosses, known as the White-winged and the Royal. In the adults it is hard to find a difference that might not be due to age or season, but one has chicks that are always white, and the other chicks that are always brown, an apparent convergence of separate species which is a most puzzling thing.

The connection by land or glaciation of the Antarctic with the other continental masses of the southern hemisphere is a question which I must omit to touch on

here for lack of time, though it has a bearing on the seals, the penguins, and other birds that we find in the region. Judging, I must own, from the most slender indications, the Emperor penguin and the Crab-eating seal would seem to have been the earliest settlers.

The furry coat of the young Crab-eater is white, and the down of the young Emperor penguin is white. It might, perhaps, be argued from this that there was formerly more reason than there is now for protective coloration in the Antarctic, such as occurs in so many Arctic species now; and so one might argue that there was some form of predatory beast from which they had to protect themselves. But I think it is possible to show that there is a general tendency for all animals that live in the polar region, and have to face intense cold, to turn white in fur or feathers. It has been suggested that this is an economy; that it costs the bird less, or is a smaller tax on its energies, to be white than to be of any other colour. One thing, I think, is fairly certain, namely, that in the south the whiteness of animals is in no case for protection, nor is it any help to any of them in obtaining food. For example, take the pure white Snow petrel, which lives on the shrimp-like *Euphausia* that are thrown up on the ice-floes by the breaking surf. It has no enemies, and can have no difficulty in obtaining food. Or the white Giant petrel, a most interesting example, because it appears to be a species in process of formation. In the sub-Antarctic seas one may see many hundreds of black or dark Giant petrels to a single white or pale one. But once the ice is entered, the proportion of white to dark rises to something like twenty per cent., showing pretty plainly, I think, that some influence is at work to make polar species white, beside the usually accepted reasons of protection, and invisibility for getting food.

I have touched too lightly on these subjects, but my time is short, and the material has not been anything like worked out.

V. PRELIMINARY REPORT OF THE BIOLOGICAL COLLECTIONS OF THE "DISCOVERY."

By T. V. HODGSON.

VERY little can be said yet with regard to the Marine collections of the *Discovery*. At present they are all in the hands of experts for description, and at the time of collection nothing but the very briefest examination was possible. Contrary to expectation, it was found that outdoor biological work could be carried on all the year round, and that even with comfort. Holes in the ice were kept going at distances varying from 30 yards to 6 geographical miles from the ship, but in the depth of winter the limit of distance was $1\frac{1}{2}$ miles. It was found impracticable at that period of the year to keep more than two holes going at the same time, and, barring accidents, their existence was limited to about three months. The collections were made in depths of from 8 to 180 fathoms. In the Ross sea, before arriving at winter quarters in McMurdo bay, a few attempts at trawling were made from the ship with varying success.

Everything goes to show that animal life is very abundant in the southern seas. Our first haul was made with a 3-foot dredge in 100 fathoms off Coulman island, and proved by far the most satisfactory. No less than sixty species were taken, and the resources of the laboratory were taxed to the utmost. Other attempts off Mount Terror and the Barrier were partial failures. In winter quarters a light dredge or a trawl was used from a whaler whenever possible, and after the

ship became frozen in, holes through the ice were cut for traps; these were assisted near the ship by a friendly crack, which enabled a line to be slipped through for a distance of 100 yards. A second line added to this enabled us to pull a light D net backwards and forwards with considerable success.

A predominant feature in the fauna was the enormous quantity of sponges, anywhere near the 20-fathom line sponges and sponge *débris* forming the bulk of the haul as a rule. Mr. Kirkpatrick informs me that this group will probably prove to contain about fifty species.

The Cœlenterata are a delicate group and fared very badly in the cold, the Medusæ and Ctenophores, which were numerous, being invariably seriously damaged by ice crystals before they could be got to the ship. Hydroids were few, though Medusæ were fairly abundant. While the sea was open a large Medusa, about 1 foot diameter, of the Chrysaora type was frequently seen but never captured. A large Periphylla was taken in two pieces from under the ice by Lieut. Shackleton. Solmundella, Phialidium, etc., were abundant, also some of the Calyconectæ, and occasionally Diphyes and Halistemma.

A very great difficulty was experienced in preserving the Ctenophores. A large Beroe was very abundant and at least three species of smaller Cydippidæ.

Two or three species of Actinians were taken and several species of Alcyonarian, including *Clavularia frankliniana* and *Umbellula Carpenteri*, (?) the latter trawled off the Barrier in 500 fathoms. Two Corals were taken in depths between 200 and 300 fathoms.

The Echinoderms were very numerous, and all hauls in shallow water less than 50 fathoms produced an Echinus, probably *Margaritaceus*, and *Cycethra verrucosa*. Fragments of *Hemiaster cavernosus* were frequently found, but only a few sound specimens. Two very fine Holothurians were dredged off Coulman island in 100 fathoms; other small ones and one or two members of the Elpidiidæ were taken off the Barrier. One or two species of Cucumaria were fairly abundant in winter quarters.

A Crinoid was found abundant everywhere just beyond the 100-fathom line. Of the Starfish a large Asterias (*A. Brandti*) was very common in winter quarters at all depths, and a single specimen of a second species was taken. Several other species were occasionally secured; one large one, about 1 foot in diameter, is closely allied to Cycethra, and another species is larger still. Ophiurids were very plentiful. *Ophiosteira antarctica* and *Ophionotus victoriæ* were not uncommon with several others.

A species of Phascolosoma was of frequent occurrence in the sponge *débris* brought up by the D net.

Nematodes are abundant in the stomachs of seals; in fact, no seal was ever seen without them. Another species was always found in the sponge *débris*.

Among the Pycnogonida, which were very numerous both in individuals as well as species, there was found a very slender form with one pair of legs more than those usually allotted to the group. This species has recently been described as *Pentanymphon antarcticum*, and beyond the extra pair of appendages does not differ essentially from the well-known genus Nymphon.

The Scottish Antarctic Expedition have found the same species at the South Orkneys, and also another, totally different, but having the additional pair of legs. This latter species was very accurately described by Eights in the *Boston Journal of Natural History*, vol. 1, 1837, under the name of *Decolopoda australis*; so that after all Pycnogonids with five pair of walking legs are nothing new. The other species may, with a few exceptions, be referred to well-known genera—Nymphon, Colossendeis, Phoxichilus, etc.

Concerning the Crustacea, this phylum, as would naturally be expected, contains a larger number of species than any other. The Decapoda are only represented by a Crangon, which appears to have a widespread distribution, and a Pandalus, both from below 100 fathoms.

Not less than fifty or sixty species of Amphipoda were taken, but with one doubtful exception these do not present any important structural peculiarities. One species occurred in great numbers, and appeared to go about in vast hordes in search of food; it was quite the usual thing to take ten to thirty thousand at a haul. Of Isopoda one very fine large species belonging to the Idotheidæ was obtained in winter quarters between 10 and 130 fathoms. What is at present supposed to be the same species was captured in large numbers by the Scottish Expedition at the South Orkneys. Three species of Arcturus were secured. Gnathia, Tanais, and the Munnidæ exist in large numbers, all of these being extracted from the sponge *débris*. One very large specimen of Gnathia was dredged off Coulman island, and a new but allied genus, quite blind, was taken as almost the only result of our one attempt at deep-sea dredging from a depth of 2030 fathoms in the pack-ice. Cymothoids were sometimes caught and occasionally seen in the stomachs of the seals killed.

In the summer a Nebalia was taken on a few occasions in considerable numbers.

As regards the crustacea of the Plankton the supply of individuals was abundant, but the number of species was proportionally small. The Schizopods occurred at times in great profusion, but not more than four or five species are expected. Only two Cumaceans were found, and those in very small numbers. Copepods were numerous and large, but in no great variety. The Ostracods were much less numerous. During the winter, hauling the tow-nets always provoked a brilliant display of an emerald green phosphorescence, chiefly from the contained Copepods and Ostracods. The large *Euphausia australis* described in the *Southern Cross* collections was met with in profusion between lats. 66° S. and 72° S., where it formed the staple food of the seals and penguins in that area.

The Polychaetes were more numerous in individuals than in species. A few species of Polynoid were abundant, and Terebellids were plentiful in the sponge roots. A Nereis was discovered commensal with an Alcyonarian. A Eunicid was taken from below 100 fathoms, and a few small species of Syllis and others were caught in the tow-net.

Sagitta was frequently obtained in small numbers, some specimens being barely an inch in length, and some were very considerably larger, probably more than 3 inches.

A very large Nemertine was taken in great abundance, and in shallow water could be seen lying on the bottom like great straps 2 or 3 feet in length, and an inch or more in width. The majority of the individuals were of a purple brown colour, but a small proportion were white. A smaller species was sometimes found among the dredge material.

Another organism gave rise to a great deal of speculation, and as a matter of convenience was regarded as a Nemertine, though suspected to be something else. It was first found entangled on Mr. Barne's sounding wire, about 80 fathoms from the bottom in a depth of 170 or thereabouts. When it arrived at the ship frozen it appeared to be close on 20 feet long, of a light brown colour, and about the diameter of an ordinary boot-lace. This organism occurred time after time on the lines, sounding and otherwise, but was always torn to shreds by the friction of the line either against the ice or the bar over which it was hauled. Two specimens were found once on the tangles in 178 fathoms, but these could not be liberated owing to the intense cold. These appeared stouter than the attenuated forms

brought up by the line. During December, 1902, a specimen was found on the tow-net line at 7 fathoms. This was liberated with care, and has been brought home, though in bad condition. In the water it appeared somewhat gelatinous, translucent, light brown in colour, though this colour was not uniformly distributed, and about a quarter of an inch in diameter. It has since been suggested that this curious organism has something to do with a Cephalopod.

The Polyzoa were extremely abundant everywhere, both in genera and species, more particularly about the 100-fathom line. On one occasion, in 178 fathoms, the trap tangles, which could not have moved over a diameter of more than 8 feet, brought up no less than sixteen species belonging to almost as many genera.

A single Brachiopod was found occasionally both in winter quarters and elsewhere below the 100-fathom line.

Concerning the Mollusca, Mr. Edgar Smith tells me the collection will prove to contain not far short of fifty species. Most of these, however, are quite small, and have been extracted from the roots of sponges and sponge *débris*. A species of Lima is very abundant there, occupying cavities just large enough for itself and lined with some fine byssus-like secretion. A fine-looking Trophon seems to be common, and a single specimen of *Neobuccinum Eatoni* was taken in 180 fathoms. Two or three specimens of a fine Chiton were captured below the 100-fathom line.

No Cephalopod was seen, but their beaks occurred constantly, though not in any great numbers, in the stomachs of the seals. A few more or less damaged shells of *Pecten Colbecki* were obtained, as well as the shells of Anatina. Numbers of empty Anatina shells could be seen lying at the bottom of the shallow water, but no living specimen of either of these two lamellibranchs was discovered.

A large quantity of a fine Cephalodiscus was taken in 100 fathoms off Coulman island, and a dead fragment was found in winter quarters at the same depth.

Ascidians cannot be said to be very numerous. One very fine specimen of the simple form was taken in winter quarters from shallow water, several individuals of a smaller species, covered all over with long bristles (?), were found in 100 fathoms, near the east end of the Barrier. Another resembling Clavellina has been taken. Only very occasionally have pelagic Salps appeared in winter quarters, but on the voyage down they were numerous.

Fishes were abundant throughout the year. The seals lived almost exclusively on them, a diet varied only with a few Cephalopods and an occasional crustacean. Notothenia and Trematomus were the genera that chiefly occurred, and several species of each genus were constantly taken in the traps. Another handsome species was taken in a well-preserved condition from the stomach of a seal, the only time it was seen. It is nearly allied to the genus Gymnodraco, if it does not actually belong to it. A very large fish, with all the characters of a Notothenia, was harpooned with a seal at No. 12 Hole. Unfortunately the hole was not enlarged to its full extent, and in dragging out the capture the fish's head was destroyed. As it was no good for a specimen it was carefully photographed, weighed, and measured. In its mangled condition it weighed 39 lbs., and its length was 3 feet 10 inches, with a girth, just behind the pectoral fins, of just over 2 feet. It formed a very good breakfast for the whole of the ship's company. No such fish was ever seen again, but skeletal remains of some approximating to the same size were found on the shore on the western side of the bay during sledge journeys.

Great numbers of small fish about 1 inch to 1½ inch were numerous in the tow-nets at all times of the year; not less than half a dozen species of these were recorded. All of these are believed to be quite young stages of larger forms.

This short note on the collections is necessarily a very superficial one, for, owing to the unexpected conditions met with, any detailed examination of the hauls was

out of the question. For one thing, the upper-deck laboratories were absolutely useless for ten months in the year, and, as a consequence, all the thawing and preservation of specimens had to be performed in an already overcrowded cabin. And for another, the discovery that outdoor biological work could be continued all through the winter involved a daily routine permitting no time for precise investigations. The capture, preservation, and storage of each day's haul proved the limit of each day's work. Taking all things into consideration, the collections cannot be regarded as large; the greater part was obtained at winter quarters in stationary traps and by using the D net, only a small proportion by trawling from the ship. What we have seen enables us to say authoritatively that the Ross sea still remains an extremely rich area for the biologist.

Mr. HOWARD SAUNDERS: We have all listened with great pleasure to Dr. Wilson's interesting paper, as well as to the papers by the other officers. There are one or two questions I should like to ask. What did he find the Emperor penguins fed upon? Captain Larsen, of the *Jason*, found they had in their stomachs the remains of large cuttlefish, and of course crustacea. One or two remarks may be made about the difference in the young of the Skua gull, because the species named after Dr. McCormick, of Ross's expedition, and only recently separated from the species found to the north of the Antarctic circle, is distinctly grey when hatched, whereas the other is buffish-white. In regard to the distribution of the Emperor penguin, on the whole the evidence, so far as we could judge from the information at our disposal, was that further west, *i.e.* towards America, within the Antarctic circle the bird became more abundant than it was in Victoria Land. That is merely my impression, but I should like to hear what Dr. Wilson, who no doubt has read everything I have read and a great deal more, has to say on the subject.

Mr. BROWN: I had the good fortune to accompany Mr. Bruce in his expedition to the other side of the Polar Regions. We did not winter in the far south, so I cannot say whether the Emperor penguin breeds there or not; but when we were off the Antarctic continent, we found the Emperor penguin in great numbers. But that was at the end of February, so it would not be the breeding season, and we cannot say whether they breed there. In the South Orkneys the Adélie penguins breed, and one or two sub-Antarctic penguins; we got the Giant petrel and the Cape pigeon, in addition to many sub-Antarctic birds. With regard to invertebrate fauna, I am afraid it is very difficult to say anything yet, because our collections are only now being worked out. So far as cuttlefish are concerned, we found a great many beaks in the stomachs of seals. They were extraordinarily common, and we found, I think, three species in the South Orkneys. The invertebrate fauna there was very rich in schizopods and echinoderms generally, as Mr. Hodgson stated. With regard to the food of the Weddell seal, we found a great many beaks of cuttle-fish in their stomachs, and we also found remains of holothurians. The Sea-leopard occasionally came south of the Orkneys, but we did not find that it bred there; it is the Weddell seal that breeds there, and in very great numbers. We only got a single specimen of the Ross seal there, and I think we only saw two others in addition to them.

Dr. EDWARD A. WILSON: With reference to the food of the Emperor and the Adélie penguins, I have not much to add to the list. Cuttlefish beaks are frequently found in the stomachs of both, but fish seem to form the principal diet of the Emperor, whereas crustaceans are the staple diet of the Adélie penguin. Stones you always find in the penguins' stomachs. Even the stomach of the youthful chick which had apparently only just come out of the egg, was already filled with stones. I think they find they can work down the bones of the fish

and the shells of the amphipods that they eat better if they have stones in their stomachs than if they have not.

As to the distribution of the Emperor, the *Belgica* saw large numbers in the pack-ice to the west of Louis Philippe Land, but I believe the largest numbers of all were what we saw in what has been called King Edward VII. Land, a place we were unable to land on because the ship was getting frozen in. As to the breeding-place of the Brown-backed petrel, Lieut. Mulock mentioned there were thousands of birds on Scott island, and I think that is the place to go with the greatest probability of finding its eggs. We saw no place which was likely to produce Brown-backed petrels' eggs.

Captain SCOTT: I think the pack ice we saw contained a great deal of old ice mixed with one year ice.

The PRESIDENT: The meeting will wish to pass a vote of thanks to Dr. Wilson for his very interesting paper, and to Mr. Hodgson for his account of the invertebrate fauna; also to Captain Colbeck for his excellent description of the pack in various meridians and in various seasons. We also have to thank Lieut. Mulock for having read the paper so well and described to us the illustrations. I may add that he himself very carefully surveyed Scott island, and that we shall thereby be indebted to him for a most accurate and valuable map of the Antarctic discoveries. I now ask you to pass votes of thanks to these gentlemen for their papers.

OBSERVATIONS ON THE ANTARCTIC SEA-ICE.*

By Captain W. COLBECK, R.N.R.

FOR the following remarks on the southern ice-pack, I have drawn on my diaries for three seasons—1898–1900, when magnetic observer of the *Southern Cross*, and 1902–1904, when in command of the *Morning* Relief Expedition. The northern limit of the pack varies according to the meridian on which it is approached, and also according to the severity of the season, as will be seen from the following summary of the three voyages southward.

On December 30, 1898, the *Southern Cross* fell in with small drift-ice in lat. 61° 56′ S., and long. 158° 53′ E., and a few hours afterwards entered the main pack. For 70 or 80 miles we steamed through small floes without much difficulty, and were then faced by much heavier and more closely packed ice, varying from 4 to 10 feet thick, in immense floes. An attempt was made to force our way through between the 160th and 166th meridian which proved futile, the ice as we worked southward becoming heavier and the floes of greater area. From January 12 to February 10 we were within 80 miles of the Balleny islands, hemmed in on all sides by heavy ice; during this time, we took advantage of every opening to the south and east, changing our position a few miles daily, but making no material progress southward. The ice in this vicinity varied considerably; at one time we would be beset between floes 4 or 5 miles square and from 4 to 6 feet thick, with no open water visible in any direction. After a few hours light southerly or south-easterly wind and a day's steaming in the open leads, we would find smaller and heavier floes, such as our Norwegian whalers called "blue" ice, 10 to 20 feet thick, with numbers of much-worn bergs within a few miles of us, at another time the floes would be smaller and honeycombed, some of them half a mile to a mile in extent, upon which it was impossible to travel except upon ski, and even then it frequently happened that the upper surface would give way and we

* Read by Lieut. Mulock.

would find a footing on a honeycombed platform about 2 feet below. During January and the early days of February we experienced several heavy gales from west-south-west, north-east, and east-south-east; with the northerly gales a heavy swell was at times noticeable, but it had no effect on the floes around us; with the easterly and westerly gales there was no swell, nor was there any appreciable change in the ice-conditions afterwards. We experienced a strong westerly drift when to the eastward of the Balleny islands. The most favourable conditions for navigating were met with after light southerly winds or calm.

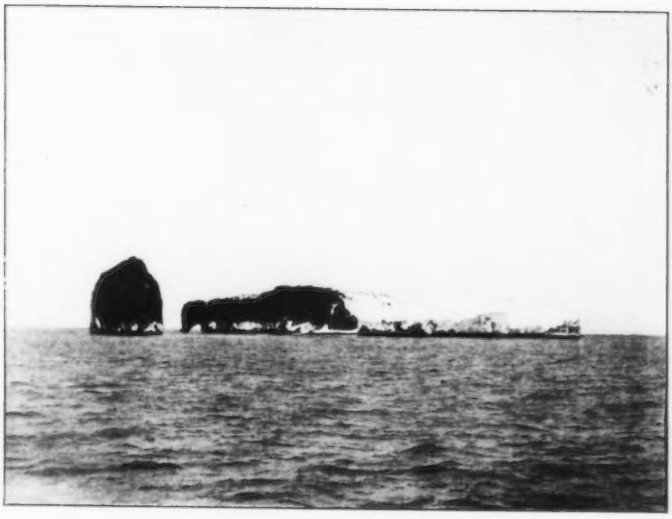
On February 7 we turned northwards, and after passing through heavy ice for forty-eight hours, fell in with loose sailing pack, in the same position where fourteen days earlier we had been faced by very extensive and closely packed floes from 4 to 6 feet thick. This was in lat. 65½° S., and long. 165½° E. Thence we steered an easterly course through loose ice, as far as 174° E. and 65° 40′ S., where open water was met with and a southerly course taken. Between lats. 68° and 69° S. we encountered a belt of pack about 30 miles broad, running east and west; but after passing through this only loose ice was seen, and we arrived at Cape Adare on February 17, 1899.

After the difficulties we had experienced to the westward in the *Southern Cross*, I had no hesitation in choosing a more easterly meridian on which to approach the pack, and decided to work southwards between longs. 175° E. and 180° E. in the relief ship *Morning*.

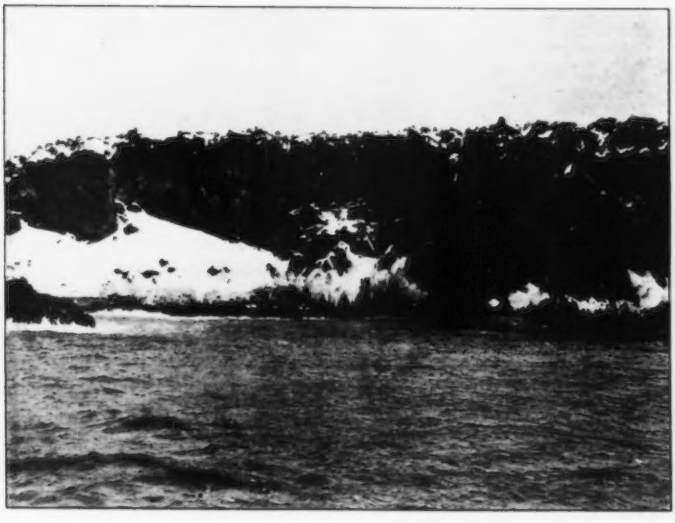
After leaving New Zealand on December 6, 1902, a course was set to cross the 60th parallel in long. 175° E., and thence due south to the pack; but in consequence of adverse winds being encountered, a more easterly course had to be taken. We saw our first iceberg in lat. 62° 5′ S., and fell in with loose pack and drift-ice in lat. 67° 40′, long. 179½° E. We entered the main pack in this locality, and made about 100 miles to the south-west through loose hummocky ice before our difficulties really began. Up to this time we had been passing through belts of pack about 2 to 3 miles broad, running in a north-westerly and south-easterly direction with a mile or two of open water between them.

On reaching lat. 69° S., long. 175° E., the pack became closer, and we fell in with a number of ice islands, irregular in shape and quite distinct from the tabular berg common to these waters; they were visible so far as we could see to the eastward, and in the pack in their vicinity some very heavy old ice was observed with evidence of severe pressure during a previous season. We worked south from this position, averaging from 20 to 30 miles a day through loose but heavy pack; the smaller floes of 2 and 3 feet ice which were observed between the larger and heavier floes showed signs of recent screwing. We again met with close pack in lat. 70° S., through which we could make but little progress. When in lat. 70° 26′ S., and long. 175¼° E., we encountered a heavy east-south-east gale, which drove us into open water in long. 170½° E., apparently extending to the coast north of Smith inlet. On the gale abating, a course was set for the coast; but the heavy floes and small bergs, closely packed along the coast and to the northward, prevented our approaching within 40 miles of it. We worked in a line of open water, between the coast pack and the loose ice to the eastward, until within a few miles of Cape Adare, where we fell in with loose ice; this, however, did not retard our passage, and we landed at Cape Adare on January 8. The ice in Robertson bay had only broken up in the vicinity of the cape, and there was every indication of its being a very late season.

On leaving Cape Adare we followed the coast-line, keeping well inshore to avoid the pack which showed up to the eastward. South of Possession island the ice was very heavy and closely packed. Coulman island was surrounded by



SCOTT ISLAND AND HAGGITT'S PILLAR.



BEACH ON SOUTH-EAST SIDE OF SCOTT ISLAND.

immense fields of ice, and in the direction of Wood bay there was one solid field unbroken as far as the eye could see. A landing was effected at Franklin Island after great difficulty, the approach between unbroken floes of flat ice, 2 to 4 feet thick and several miles in length, being very tedious. From Franklin island we stood away to the north-eastward into open water, and then skirted the pack to Cape Crozier. The run from Crozier to McMurdo bay was through very heavy and close pack, and our success in making the passage as we did between Cape Bird and Beaufort island was mainly owing to the strong westerly drift on the northern shore of Ross island. After clearing Cape Bird we fell in with open water until faced by the field-ice extending to the *Discovery's* winter quarters.

The following year, we left Hobart on December 6 in company with the *Terra Nova*, we fell in with our first iceberg in lat. 62½° S., long. 177° E., and entered the pack on December 26, in lat. 66½° S., and long. 179¼° W. The ice on the outer edge was apparently old ice about 10 feet thick, and quantities of screw and hummocky ice were observed. After passing through about 60 miles of very heavy and closely packed ice, we were able to make a good course southward through loose and open pack until in lat. 69½° S., when we encountered a fresh gale which closed up all the leads—we were compelled to lay to for thirty hours in lat. 69° 22′ S., and long. 178° 37¾′ E. On the weather moderating, the ice opened up, and we had no further difficulty in making our course good, passing through the outer edge of the pack in lat. 70° 20′ S., and long. 176° 53′ E.

We found the Ross Sea quite open, and although we crossed our last year's track several times, no ice was met with, and we were able to traverse the same distance in four days which had taken us twenty-two days to do in the previous year. Off Beaufort island we passed through a belt of loose ice, about 30 miles broad, and arrived at the edge of the field of ice in McMurdo bay on January 5.

From the experiences, as related in the foregoing, I have no hesitation in saying that the pack should be entered between long. 178° and 180° E., as early in December as possible, and so take advantage of the whole of the open season. The ice between these meridians being lighter, more open, and easier to negotiate than to the westward, and moreover having no extent of land nearer than the Balleny islands, there is very little danger of the ship being damaged by pressure.

In the event of a ship going south for geographical work during the summer, I would strongly recommend that a due easterly course be taken after reaching the latitude of Cape Adare, with the view of examining the east side of the Ross Sea. The ice islands and the nature of the drift-ice we met with during our first cruise in the *Morning* gave every indication of having broken away from a glaciated coast-line in that locality.

The difficulty experienced by the *Southern Cross* when attempting to force our way through the pack in the vicinity of the Balleny islands was, no doubt, due to the prevalence of easterly gales in the Ross Sea, and the westerly drift north of Victoria Land, both of which tend to drive the pack in that direction, where it is held up by the islands until late in the season, and does not disperse until the sea to the westward is free from ice. We found no uniformity of thickness when in the pack, the nature of the ice varying from hour to hour.

I consider that the middle and the southern edge of the pack are the most difficult to navigate. At the northern edge loose drift and water-worn ice was met with for several miles before the pack was actually reached; and in the case of the *Southern Cross*, and the first voyage of the *Morning*, we sailed through from 80 to 100 miles of loose ice before meeting the close pack. On our second voyage in the *Morning*, however, when only a few miles from the northern edge, we were faced by as close and heavy pack as any we encountered during the voyage. In the

first year we had no southern limit, the pack extending practically to Cape Crozier. On the second voyage we were more fortunate, and, after passing through 30 miles of very loose sailing pack, we got into open water to the south, in lat. 70° 22′, leaving a clearly defined line of pack behind us.

Our first season, 1902–1903, I consider to have been exceptionally late and severe, and am of opinion that the conditions we met with in 1903 and 1904 were normal, and were such as might reasonably be expected by any one navigating in these regions. This conclusion is arrived at by comparing the ice conditions we met with during the *Morning's* two voyages with those observed around Cape Adare during my winter there in 1899.

A strong northerly current exists on the coast of Victoria Land, and is in a great measure responsible for the rapidity with which the ice clears away during the open season. It was an agreeable surprise to me to find so much open water on my return voyage in March, 1903; I did not think it possible that such a great change could take place in six weeks. Our only difficulty was when passing between Beaufort island and the Western mountains, where we were stopped by young ice from 4 to 8 inches thick, extending to the horizon on all sides. We were, however, favoured by a south-westerly gale, and managed to work through it under sail and steam, meeting with pancake ice as far as Coulman island. The coast-line was fringed with pack, but no ice was visible to the eastward.

On the return voyage in 1904 no new ice was observed, and with the exception of a small belt of pack south-west of Coulman island, the passage was made in open water. That there is a westerly drift on the north coast of Ross island was proved during our first voyage; we had further evidence of this when lying in McMurdo bay, and also that the current turned northwards along the coast of Victoria Land. I am of opinion that this current takes a north-westerly course after passing Cape Adare, and that it is the ice from further south, piled up on the coast, which has so far prevented an examination of that part north of Robertson bay.

On December 25 we sighted two small islands, bearing south-south-east, about 25 miles distant. We took a sounding when about 5 miles north-north-west of them, and got no bottom at 1000 fathoms. The larger island is about ¼ mile long and ⅛ mile broad, lying in a N. by E. and S. by W. true direction, the northern end being about 126 feet high, and "steep to." The southern end was lower, and partially covered with an ice-cap sloping from the northern end, and appearing to get much thicker where it discharged into the sea. The northern extremity was almost bare of snow, much weathered and water-worn at the base of the cliffs. In each of the northern points there was an arched rock, the larger of which was about 80 feet high and 50 feet broad. The smaller island, which was almost circular, was about 200 feet in diameter, to a height of about 185 feet, with a conical top (the summit of which was about 209 feet above the sea-level), and was situated nearly a cable's length to the north-north-west of the larger island.

Whilst pulling round the larger island we noticed two beaches—one on the west-by-north, and the other on the north-north-east side. The first we estimated at 80 feet long, and the latter 50 feet, both shelving very rapidly, and making it impossible for us to land. The W. by N. beach sloped more gradually, but the approach was equally dangerous, owing to a number of rocks partially covered by the sea, lying about 100 feet from the beach. We managed to effect a landing on the southern part of the island by backing the boat in and jumping on a low rocky ledge as we rose to the swell. Having collected specimens of rock near our landing place, we returned to the boat, and pulled round to the smaller island. There was now no snow on the latter, which looked like basaltic rock as far as the cone, which had a reddish brown appearance. About a third of the way up

LOOSE PACK, NORTHERN EDGE SHOWING LINE OF OPEN WATER.

FLOES BREAKING AWAY FROM THE FIELD-ICE IN MCMURDO BAY.

the cone there was a thin stratum of grey-coloured stone, which appeared to separate the black basaltic rock from the reddish formation above.

Thousands of birds—Wilson's, brown-backed, and white petrels, prions, and cape pigeons—were seen near these islands, the northern end of the larger and the cone of the smaller one being covered with them.

On the following day we had fine clear weather. Good observations for latitude and longitude were obtained, and Lieut. Mulock made a sketch-survey, and took soundings all round the islands. The position of the centre of Scott island is lat. 67° 24½′ S., long. 179° 55½′ E.

THE GREAT ZIMBABWE AND OTHER ANCIENT RUINS IN RHODESIA.*

By RICHARD N. HALL.

Progress of Researches.—Before introducing a discussion as to the recent researches respecting Rhodesian antiquities, I would venture to express my high appreciation of the work of the late Mr. Theodore Bent at the Great Zimbabwe. Having devoted eight years to the study of the ancient monuments in various parts of Southern Rhodesia, and having resided for over two years at Great Zimbabwe, I have no hesitation in stating that I have found Mr. Bent's work to be both valuable and reliable. Mr. Bent experienced great obstacles in his examination of these ruins. He found the ruins to a great extent buried in soil and *débris*, and covered with dense and almost impenetrable jungle. He was also seriously handicapped by the shortness of his stay, by an insufficiency of labourers, and by adverse climatic conditions; yet he was able to sweep away many of the myths, romances, and theories which had always surrounded the Rhodesian remains. But to Mr. Bent belongs the credit of giving to this problem an entirely new orientation. This new orientation is now unreservedly recognized in the highest scientific circles of Europe as practically incontestable.

The recent researches have yielded additional internal evidences in support of Mr. Bent's conclusions, that the oldest portions of the Great Zimbabwe, and a certain number of the ruined structures elsewhere, testify to Southern Rhodesia having once been a colony of the ancient empire of Saba, in South Arabia.

The Royal Geographical Society was primarily responsible for the visit of Mr. Bent to Rhodesia. This Society, by its practical assistance and its consistent interest in our ruins, has always acted *in loco parentis* to researches in Rhodesia. In a sense, the Rhodesian monuments may well be considered as one of the specialities of the Royal Geographical Society. All South Africans will, with confidence, continue to look to the Royal Geographical Society for further manifestation of its support and interest in this direction.

---

* Read at the Royal Geographical Society, January 23, 1905.

Not a single one of the hundreds of ruins in Rhodesia can be said to have been more than partially explored. Many ruins of major importance, some rivalling in certain respects the Great Zimbabwe, have never been seen save by casual travellers, while it still requires more than the labour of a lifetime to unearth but a portion of the Great Zimbabwe area. Dr. Petrie informs me that his difficulty in Egypt is not that of means, but of obtaining sites to explore. In Rhodesia we have the sites, but do not possess the means. Research in Rhodesia has always been by unassisted individual effort, and hence it has been spasmodic and without organized system.

Sir William Milton, the Administrator of Rhodesia, has shown in a practical form his deep interest in the preservation of the ruins of Great Zimbabwe. He is entitled to your warmest thanks for taking timely action to secure their preservation. But every pioneer bemoans the preventable dilapidation at many of the most important ruins throughout the country. Whole lengths of high walls are disappearing. These prehistoric buildings can never be replaced. This is a matter of grave concern for archæologists everywhere, and one that demands prompt attention.

Since Mr. Bent published 'The Ruined Cities of Mashonaland' in 1892, decided progress has been made, both at Great Zimbabwe and elsewhere, in the investigation of our ancient monuments. The last three years have witnessed the following advance in these researches:—

(1) The re-examination of Great Zimbabwe, including the unearthing of floors, passages, drains, and walls, with a detailed description, accompanied by plans, sections, and photographs, of all architectural features, methods of construction of the ruins of several ages in this group, thus constituting a permanent record of Zimbabwe which must prove of incalculable value in the discussion of these ruins.

(2) The re-examination, in the light of discoveries at Zimbabwe, of ruins elsewhere in Rhodesia which had previously been located and described.

(3) The discovery and examination of numerous and altogether fresh ruins of both major and minor importance, the existence of which was unsuspected, the reports on these ruins including plans, photographs, and detailed descriptions.

(4) My recent inspection, on behalf of Mr. Rhodes' trustees, of the ruins of the Inyanga area, including (*a*) hill terraces, (*b*) hill forts, (*c*) aqueducts, and (*d*) so-called "slave-pits," the reports on these ruins and on the relics containing plans and photographs.

(5) The comparisons, by means of photographs and written descriptions, of the ruins of Mount Injakafura district with those at Zimbabwe and elsewhere in Rhodesia.

(6) The plans carefully prepared by Mr. Franklin White of certain

ruins in Matabeleland, and also his recent survey of the elliptical temple since the explorations.

(7) The inspection and reports on some scores of stone-built villages, and stone rampart forts on hills, of the Makalanga and Barotse.

(8) The successful tracing of several additional chains of forts in several parts of the country, especially in the Motelekwe and Sabi districts.

(9) The securing of the exact locations within numerous ruins of some two hundred relics and "finds," with particulars of their associated articles, their locations on certain floors, and the associated features of architecture and construction of the buildings in which they were found,

VIEW OF INTERIOR OF ELLIPTICAL TEMPLE FROM SUMMIT OF NORTH WALL.

these buildings being of several distinct types of architecture, each yielding distinct classes of relics, both buildings and relics representing periods extending from pre-historic times to within, in some instances, but a few score years ago.

(10) The accumulation of a vast fund of expert opinion as to the relative ages and the origins of the relics and "finds," and their parallels and identities in other lands.

But while these and other internal evidences have been obtained from the actual ruins, other researches have, within the last few years, been prosecuted in various quarters, from which much additional light has been, and may yet further be, shed on the origin of the Rhodesian monuments. Some of these may briefly be stated as follows :—

(1) The very marked advance within the last few years in archæological researches in Arabia and the Near East, and further examination of historical records concerning the peoples who are now believed to have been responsible for the oldest type of building in Rhodesia. It is now possible to speak with fuller knowledge and greater assurance of such matters, which before were largely subjects of conjecture only.

(2) These remarks apply also to recent researches with regard to the close connection existing in mediæval times between Arabia, the Mozambique coasts, and Rhodesia.

(3) The recent discoveries by M. Grandidier and other savants of the traces of the influence of Sabæans, Phœnicians, and Idumean Jews of the Red sea on the Mozambique coasts and Madagascar.

(4) A fuller knowledge of the extent and methods of ancient gold-mining in Rhodesia, as apart from gold-mining in these regions by mediæval Arabs and Portuguese, and also by indigenous people. The confirmation of the suggestions made by the late Mr. Telford Edwards as to widely distinct mining operations at totally different periods and by different peoples.

(5) The study now in hand of such of the trees and plants found in the ancient mines and ruins' area as are not indigenous to South-East Africa.

And (6) a largely increased fund of information as to the history of the once partially civilized Makalanga, or "People of the Sun"—both of Matabeleland and Mashonaland—from the earliest mediæval times to the present day, and the preparation by Dr. John Helm and the Rev. A. A. Louw of the first grammar of the Chicaranga language.

It will thus be seen that within the last few years archæological and antiquarian researches in Rhodesia have made very great progress, and the results so obtained, added to our previous knowledge, enable us at last to pronounce some judgment on certain of the distinct types of ruins to be found in this country.

Variety of Ruins.—It may be taken as a very modest estimate that there have been located in Rhodesia no less than three hundred distinct ruins and groups of ruins, and these, or such of them as were first discovered, were classed by all writers as "ancient," this term having also been applied to many of such ruins as are of mediæval and even of later times.

Probably it would be more correct to say that the term "ancient," as relating to the suggested Sabæan occupation of Rhodesia, can only be applied to a few scores of the three hundred of Rhodesian buildings, though later investigations may show that certain other ruins are also entitled to rank under the title of "ancient" as so understood. Of this older class of ruins, the oldest portions of the elliptical temple and of the Acropolis ruins, and probably certain walls in the Valley of Ruins, may safely be considered to represent the most ancient form of architecture extant in Rhodesia.

But there are many ruins showing distinct forms of architecture and construction hitherto termed "ancient," and once considered to be such, which can now be shown to be ancient in a modified sense only—that is, though they bear evidence of some antiquity, the manner of their construction and the nature of the relics yielded on their original floors, point to a period much later than any Sabæan period.

There exists a further type or class of ruins of certain well-defined

GRANITE-CEMENT PLATFORM AND STEPS, AND CARVED SOAPSTONE BEAMS, NORTH OF COUNCIL TOWER, DISCOVERED 1903.

style of architecture and construction which give evidence of erection at a still later date, and these yield no relic which, in the opinion of the highest expert authorities, can date back beyond the thirteenth, fourteenth, or fifteenth centuries of this era. To these two latter classes, I believe that the bulk of the ruins in Rhodesia belong.

Again, ruins exist, also hitherto styled "ancient," which have clearly been the work of some comparatively later indigenous people, the construction of which does not suggest any controlling influence of a foreign race. These appear to have been a crude reproduction by natives of

the older and much superior buildings in the country. In this class of poorer construction, nothing save distinctly native articles are to be found. Some of these structures are doubtless several centuries old, but others are of later date.

In 'The Ancient Ruins of Rhodesia' the authors defined two principal classes and ages of ruins to be found in Rhodesia, and these were respectively called First and Second Period buildings. From the descriptions of these distinctive styles of architecture therein set forth, I have, after three years' additional exploration work in several types of ruins, nothing or hardly anything to withdraw, but, on the other hand, very much more information to strengthen the argument, which can now be carried much further, even beyond the reach of controversy.

It is from a consideration of the type of first period ruins alone that authorities can demonstrate that the architecture of the oldest ruins was not evolved and did not originate in Rhodesia, but was directly imported from the Near East.

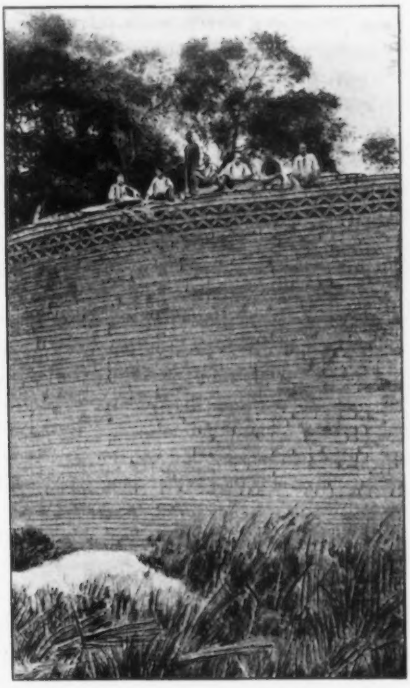
Evidences of Ancient Civilization.—It can fairly be asked, What evidences exist of ancient civilization and arts on the part of the builders and occupiers of the ruins of the earliest period? These are not far to seek. Looking at the Great Zimbabwe, we find them to be abundant. There is overwhelming proof in this direction in the actual walls, in the relics discovered on the lowest floors, and in the "finds" of gold of the early period, and in the character of a religion which constrained the ancients to devote such an immense amount of patient labour and such marvellous constructive skill in the plan, erection, and decoration of their temple. The Zimbabwe temple is now admitted on all hands to be the finest and most intact example of a Nature-worshipping shrine known to the world.

The mural decoration of chevron pattern, the monoliths, and also the remains of small towers on the summit of the east wall immediately over the pattern, the great tower of conical form, the platform, and the general plan of the structure, all point unmistakably to some knowledge of geometry and astronomy on the part of the builders. The application of these sciences for Nature-worshipping purposes was common to the ancient Semitic peoples, whether of Babylonia—the cradle of the zodiacal science—Phœnicia, Arabia, and elsewhere. The astronomical knowledge of the Semitic race was profound.

But whether the ancients of Zimbabwe carried out the principles of these sciences to their full extent is a matter which for the present is *sub judice*. At any rate, it is obvious that some of these principles were applied at Zimbabwe and at some other ruins, and that the ancients by these means marked off the seasons and periods of the year, and so provided the elements of a calendar, fixed the times of agriculture, and marked the festivals held in honour of natural powers. Knowledge of even the elements of such sciences could not

be otherwise treated than as pertaining to people who were largely civilized. Whatever the degree of knowledge of these sciences possessed by the architects of Zimbabwe and other ruins may have been, it is quite a moral certainty that even the cruder methods of their application were imported from the Near East, and did not originate in South-East Africa.

But there is not lacking authoritative opinion that the application of such sciences to the buildings of Zimbabwe enabled the solar and



CHEVRON PATTERN EAST MAIN WALL, ELLIPTICAL TEMPLE.

astral worshippers to observe the planets and stars, but most probably those of the northern hemisphere. The right ascension of the sun, the heliacal rising and the meridian passages of stars are believed to have been noted at Zimbabwe. Solar and astral worship as evidenced at Zimbabwe must have been coeval with an advanced form of civilization.

The older walls of the temple to no less extent envisage the fact of a high state of skill in architecture on the part of the builders.

One has but to glance at the grandly sweeping and massive walls for convincing proof on this point. The architectural features declare loudly the skill and art of the ancient builders. The even courses, the carefully selected blocks, the beautifully worked out batter or lean-back faces of the walls, so free from defects of construction, the elaborate system of drainage contemplated when the first foundation stones were laid, bespeak an art which baffles and amazes all practical builders of to-day. Such a monument of architectural and constructive skill as these grey walls present does not testify of an uncivilized race.

But the ancient builders were past masters in the science of military defence. Traverses, buttresses, screen-walls, intricate entrances, narrow and labyrinthine passages, sunken thoroughfares, rampart walls, banquettes, parapets, sentry recesses, and all other devices of a people thoroughly conversant with military engineering and defence, are the prevailing features of all first period buildings throughout the country. These, in their ingenuity, massive character, and persistent repetition at every point of vantage, astonish the best experts of modern military engineering science. The ancient builders were military strategists of the highest order. Such a demonstration in this direction do these stupendous walls afford that one's mind is forced to the only possible conclusion that their constructors must have been a civilized race.

The ancient gold found so plentifully on the lowest floors afford similar testimony to the skill of these ancients. Gold ornaments of most excellent make, and so pronounced by jewellers at Home, could not have been the work of an uncivilized people. Engravings on some of the ornaments, so minute and delicate that nineteen out of twenty persons examining them would not detect the presence of decoration, bespeak artistic skill and workmanship of highest order. Tacks of gold so microscopic in size that without the aid of a magnifying glass it is often impossible to say which is the point and which the head. Work which, one would suppose, must have caused the ancient goldsmith to go blind at an early age is inconsistent with the idea of a lack of civilization. Their extensive smelting of gold and the employment of fluxes, now analyzed, might also be cited as additional evidence to the same conclusion.

The carvings of beautifully symmetrical and massive soapstone bowls and their decorations, also the carved soapstone beams, and similar articles, tell of a sculptor's art which was by no means crude.

But one turns to their gold-mining operations and sees written large in reefs that these ancients possessed a wonderful knowledge of mineralogy. The many hundreds of ancient gold-mines scattered thickly over the whole country lying between the Zambezi and Limpopo rivers yield evidences of the ancients' skill in metallurgy. They picked out rich shoots, patches, and pockets with marvellous cleverness. They knew the assay value of the quartz they worked. They differen-

tiated the worth of "footwall" or "hanging wall" as the case might be. The sinking of shafts, the driving of long adits, the avoidance of the more refractory ores, testify to their skill as miners.

Taking all these evidences into consideration, and knowing that these ancients extracted some seventy-five millions of pounds sterling worth of gold—and this is a very reasonable estimate—it is impossible to conceive any other people than those experiencing the advantages of civilization, and of extensive knowledge of mining in other countries,

PATTERN PASSAGE, ACROPOLIS, LOOKING EAST.

to have carried on these operations, which were conducted on such inconceivably extensive lines.

The argument could be developed much further. For instance, the arrangement and distribution of the ruins of the first period throughout the whole country, whether as capital centres, or in districts, or in chains protecting routes at strategic points, reveal an admirable system of organization having once been in existence, an organization

by some superior race possessing an intelligence which is simply marvellous.

The lecturer, by means of plans and sections of four distinct ruins, showed the methods adopted by the ancients for fixing times and seasons; and later, by means of a large number of magnificent photographic views thrown on the screen, conducted the audience on a tour of the Great Zimbabwe ruins, pointing out features of ancient architecture, and explaining many matters of great interest, including the numerous prehistoric relics discovered by him during his recent explorations at these important ruins.

Before the paper, the PRESIDENT said: It is now upwards of fifteen years ago since our lost friend Theodore Bent read us a paper on the interesting subject which will occupy us this evening. I have great pleasure in introducing Mr. Hall to the meeting, who has devoted many years to these researches, and will give us, I am sure, a most interesting account of them. I will now call on Mr. Hall to read his paper on "The Great Zimbabwe and other Ancient Ruins in Rhodesia."

After the paper, the PRESIDENT said: I am afraid it is too late in the evening for us to enter into a discussion, but I am sure it has been a great satisfaction to all of us to hear from Mr. Hall how accurate and how useful have been the labours of our old friend Theodore Bent. Of course, as we have seen and heard to-day, Mr. Hall has done much more, having been many more years at work, and I think what has struck me most, and probably has struck the meeting, is how history may be written without any books. By a careful and accomplished investigator, like Mr. Hall, we are informed simply by the studies of these ruins how in most ancient times a colony from Asia established itself in the centre of Africa, and how a great oceanic trade was continued for several centuries. We have been able from these ruins to learn the method of building of these colonists, their style of art and of ornamentation, their system of drainage, their system of constructing aqueducts, the character of their religious rites, and even the age in which they were established, the chronology, and the fact that they departed suddenly—all this we learn, not from any books, but from the studies of ruins by an able man like Mr. Hall. You will all wish to pass a very cordial vote of thanks to him for the way in which he has explained to us the history and the story of these ruins by his illustrations and by his very lucid account of them. I have much pleasure in proposing a hearty vote of thanks to Mr. Hall for his interesting paper.

EXPLORATION OF WESTERN TIBET AND RUDOK.*

UNDERTAKEN BY CAPTAIN RAWLING AND LIEUT. HARGREAVES, OF THE SOMERSET LIGHT INFANTRY, IN 1903.

By Captain C. G. RAWLING.

THE expedition into Western Tibet, undertaken by Lieut. Hargreaves and myself during the summer of 1903, had for its chief object the extension of Captain Deasy's survey made in that direction in 1896.

Every assistance was given us by Colonel St. G. Gore, Surveyor-

* Map, p. 480.

General of India, including the loan of all necessary instruments. A sub-surveyer, Ram Singh by name, was also lent to the expedition, and proved himself a clever and painstaking draughtsman.

Leh, the chief town of Ladak, formed the base from which the expedition set out, and here the caravan men were engaged, and the ponies, to the number of forty-three, bought. Over sixty yak were hired from the town of Tankse, for the purpose of carrying grain for the ponies. The expedition consisted of Lieut. Hargreaves and myself; Babu Ram Singh, sub-surveyor; Abdal Khalik, the caravan bashi (a well-known man who had been formerly employed by Captains Bower and Deasy); four Kashmiris, six Argoons, and seven Ladakis.

On June 3 the expedition left Phobiang, the most easterly inhabited spot in Kashmir territory, following the usual route taken by former travellers, over the Marsi-mik La into the Changchenmo valley, and from there over the Lanak La into Tibet. From the eastern side of the pass we descended into the Sumjiling plain, which Captains Bower, Deasy, and Wellby had also traversed, and marched along it in an easterly direction to the large fresh-water lake of Arport Tso. This part of the route is already well known.

The hired yak, being slow movers, were directed to follow us to this lake, and here Lieut. Hargreaves remained some days, in order to bring on the expected grain.

In the mean time I set out in a south-easterly direction on a route lying at first to the south, and then to the north, of that taken by Captain Bower in 1890. I then turned due north, and struck into Captain Deasy's track at Antelope plain, the furthest point east reached by him. Here Lieut. Hargreaves and I had arranged to meet, but on the second day after reaching the place, messengers arrived from him with the information that twenty out of twenty-five of his ponies had been killed by a blizzard, which had raged for four days. They also stated that he had attempted to reach our pre-arranged meeting-place, but that at Yeshil Kul the five remaining animals had broken down, and that he was now encamped at that lake, unable to move backwards or forwards.

On hearing this news I hastened to join him, travelling by the route which Deasy had followed, and found him encamped on the shores of this lake. The reason for his being left in this plight proved to be that the hired yak-drivers, whom we had trusted to follow us, had thrown away their loads of grain, and had deserted with their yak, not one having arrived at Arport Tso as agreed upon.

Previous to this meeting, however, my party had explored a district unknown to the European. After moving south for 4 miles along the western shore of Arport Tso, the road led up a narrow arm of the plain into the heart of the Arport Tso mountains. These mountains are conspicuous by reason of the contrast of colour; they resemble piles

of coal-black stones, and are covered by a field of snow, from which glaciers pour down each valley, the contrast being very conspicuous and picturesque.

A moderately easy gradient leads up to the Lungnak La, 18,650 feet. On the summit of this pass, extending for a distance of 3 miles, is a level stretch, the soil of which is composed of partly disintegrated granite, and infiltrated with water. The descent on the far side is easy, and leads into an immense plain lying north and south. Crossing this plain from west to east, one short march further on, the road turns south to the shores of Shemen Tso. This lake, which is over 100 square miles in extent, is bitterly salt, and in shape very irregular, with numerous rocky promontories running into it from east and west. At some former date it evidently occupied a much greater area. The shores slope gradually, and are covered with grass. The northern shores and neighbouring valleys are frequented by enormous numbers of wild yak, antelope, gazelle, and kiang. To the east and south the hills are of a light colour and barren, while to the north and west they are dark and fertile. But one stream runs into the lake, and that from the east. About half a mile from the shores of the lake, at a spot where the camp was pitched, an area of about 5 acres in extent was covered with ice, over which lay a thick layer of loam, upon which grass grew luxuriantly. At various spots on the surface the ice had melted to a certain depth, forming holes, some of which were full of fresh water. In the others, which were dry, wolves had taken up their abode, and had lain in wait for antelope coming to feed or drink, as was evidenced from the fact that in and around these lairs the remains of dead wolves and of their victims lay in large quantities.

Our road had brought us out at the north end of the lake, from which point the caravan struck east across a ridge of mountains into a plain, to which was given the name of Kiang plain, on account of the immense herds of these animals to be found there. To the north and east of the plain lie the Largot Kangri and Aru Tso ranges. Of these two magnificent ranges of snow-clad mountains, the Largot Kangri runs roughly east and west; and from the east end of that range the Aru Tso mountains run south.

Our road took us into the angle between the two, where, on one of the lower spurs, we encountered a family of Tibetan nomads. These people were here for the purpose of hunting, and obtained their living by drying the flesh of the animals slain and selling it in the villages to the south. After spending a night in their neighbourhood, we, the next morning, marched north-east, and, crossing a snow-clad ridge, entered the upper end of a narrow valley, down which ran a small mountain stream. As we travelled down the valley the rivulet grew rapidly into a rushing torrent; the rocky mountain closed in on either hand; marching became more and more difficult, until late in the

KIANG PLAIN.

ALUNG, KANGU RANGE IN THE DISTANCE, 24,000 FEET HIGH.

WESTERN TIBET SCENERY

ARPORT TSO.

afternoon we reached the brink of a waterfall 15 feet high, that barred all further progress. On either hand rose enormous precipices, and it became evident that it would be necessary to retrace our steps for a considerable distance before a way of escape could be found. The caravan had hardly covered one mile on the return journey before darkness came on, and the camp was pitched in a narrow barren ravine on the right bank of the stream. On the very brink of the waterfall which had barred our progress, above what appeared to be the highest limit of the rise of the stream, were found the bones of two ponies, and at the foot of the waterfall were lying the skeletons of two others. The surprising thing about these skeletons was that each of them still had on its hoofs shoes of a pattern common in India, but quite distinct from the type used in Tibet. No remains of harness or equipment could be seen, and how these animals came here is still an unsolved problem. A fresh attempt was made at daybreak to escape from the trap we had walked into. The caravan continued up the nullah where we had camped for the night, and entered a promising valley with a considerable stream running in the required direction. The spirits of all rose at the prospect of once more reaching the open plain. One mile further on we entered a gorge similar to the one which had barred our route the previous day. The route, half an hour's weary travel, was found to be absolutely impossible for man or beast. Great ridges of limestone lying at an angle of 45° rose on either hand, while the bed of the stream was filled with immense boulders of concrete. The track of a wild yak was observed, skirting along the mountain-side, and, though hazardous, we determined to make every endeavour to follow this path and to avoid any more *détours*.

Half an hour's severe struggle, and the ponies reached a narrow ledge of shale. The path was all but impracticable, lying as it did in and out of ravines, round precipices, up and down slippery slopes of rock, and over great boulders. However, caught like rats in a trap, we were ready to welcome any chance of escape. Loads were removed dozens of times, ponies were pushed and pulled up places nothing would have tempted them to try by themselves, and the baggage was carried on the backs of the willing drivers. Fortune favoured us, for though many animals fell, but one was lost.

At six in the evening the tired men and animals reached the plain of Memar Chaka, the march of 3 miles having taken twelve hours to accomplish. Snow had fallen daily since we had left Arport Tso, and this had added much to the difficulty of crossing the range.

Memar Chaka, the bitterly salt lake which we had now reached, has an area of about 50 square miles. The plain all around has a width of about 5 miles, the soil being rich and fruitful. Signs were plainly visible of the lake having been at some remote period about 80 feet higher than its present level. But few animals and birds were to be seen.

The country to the east changed considerably in character as compared with that which we had just left behind us, for now low rolling hills took the place of the former rugged precipitous ranges.

Entering these hills, we met more nomads, who called their valley by the name of Pallo Letok, and who said that they were the first arrivals of the year from Lhasa, and had come for the purpose of digging for gold. Many men, they declared, were already at work in the neighbouring nullahs. The valley in which these people were found was filled from end to end with old diggings, most of which, however, were carried to a depth of only a few feet. It was evident that the spot was rich in the precious mineral, but no information as to the amount of gold to be found could be obtained from our Tibetan friends.

Beyond this undulating range of hills lay a lake entirely frozen over, and having an area of nearly 20 square miles. As the nomads appeared ignorant as to its existence, it was named after the late Surveyor-General of India and called Gore Tso. Round its shores, piled into great ridges, lay a snow-white mass of carbonate of soda and sulphate of magnesia. The outline of the lake was regular, and the shores flat, no vegetation growing within half a mile of the water. On these shores, otherwise destitute of game, I shot a splendid antelope with 27¼-inch horns. Leaving the lake behind and continuing to travel to the east, we found that though grass was plentiful, yet that game remained scarce.

One march further on another salt lake similar in size to Gore Tso was seen, and then we arrived at an unoccupied goldfield, the entire valley for miles being a mass of pits and piles of rubbish. In all probability this field had been worked during the previous year, for the water runs and dams were clear and sharp. From this goldfield we entered an immense plain, along the skirts of which the caravan travelled. Deasy group lay directly to our north, a mighty mass of rock and snow rising to a height of well over 21,000 feet. The passage of this range was one of great toil and privation, two ponies succumbing on the road. The crossing took two days, Antelope plain being reached on July 9.

During the march it was found necessary to climb a peak of Deasy group 20,000 feet in height, in order to find a practicable road. From the summit a glorious panorama was visible. To the north, distant about 60 miles and stretching to the east as far as the eye could see, lay the mighty Kwen Luns, an endless range of snow. At a distance of perhaps 150 miles rose a snow mountain of regular outline, overtopping the remainder by thousands of feet. This great peak we were unfortunately unable to fix, as it was never seen again. To the east and north-east appeared an endless barren plain, while to the south-east and south rose ridge beyond ridge of rugged ranges with open plains between.

LOOKING NORTH FROM DEASY GROUP.

BEACH-MARKS FORMED BY RECEDING WATER.

To the west and close at hand lay a glittering snowfield—truly a glorious scene.

The day after reaching Antelope plain, search parties were sent out to find Hargreaves' camp, with the result that two of his men were encountered. On hearing the bad news about the straits into which Hargreaves' party had fallen, an immediate return to render him assistance was decided upon. The road followed when rejoining this party was that taken by Captain Deasy in 1897, and as this route is known, nothing need be said about it, except that it passes through an arid salt and barren country.

Hargreaves, his party, and the remnants of his caravan were found and brought to a camp, where, in 1900, Captain Deasy, being unable to proceed on his intended journey across Tibet, had buried many pony-loads of stores. Two of our men, sub-surveyor Ram Singh and Soonam Tsering, had been members of his expedition, and knew the exact position of the hidden treasure, for such it was in the circumstances. This was now dug up, and was found on the whole to be in excellent condition. The waterproof sheeting with which the stores were covered had deteriorated, and water had recently soaked through it, partially ruining the Indian corn; nevertheless, much valuable grain in good condition was dug up, and on this the famished ponies were at once fed. Other valuable goods were also found, such as pony-shoes, rice, spices, and flour.

At this camp, which was in a sheltered ravine a few miles to the east of Yeshil Kul, we halted for ten days. During this period ten of the stronger ponies had been sent back to bring on the stores left behind by Hargreaves, while Ram Singh made a journey into the Kwen Lun mountains and along their southern slopes.

While waiting at this camp the country round about was well explored. Game was scarce, but sufficient antelope were found for the requirements of the camp. Borax was found in large quantities close to the tents. The surrounding country was impregnated with carbonate of soda and salt to such an extent that some of the streams were undrinkable. All of us suffered considerably from drinking the water which flowed past the camp, and it was not until a well had been sunk and fair water obtained that the ill effects left us.

On July 24 the ponies returned laden with stores; quite half of these goods we were unable to take on with us, valuable as they were, and so they were buried with Deasy's remaining stores in the old hiding-place. In this hole, and well covered in now, lie seven yalldan of tinned food, besides maunds of flour, rice, etc. I shall be very pleased to give an exact description of the place to any one who may be desirous of visiting this region at a later date.

On July 26 the whole caravan, with the exception of Ram Singh and his party, arrived at the standing camp on Antelope plain, which

was found just as it had been left. Here it became necessary to bury more stores, for tents and instruments had to be carried on, and at this point Ram Singh rejoined us, having done excellent work in the Kwen Luns. For the first few days after leaving us he had found water and grass in goodly quantities, but the face of the country gradually changed, until at last he was forced to return to us, as the ponies were unable to obtain any nourishment on the stony hillsides.

The weather had of late been very hot, on one day the thermometer having registered 70° Fahr. in the shade. Thunderstorms rolled across the plains daily, either rolling up from the west or forming on Deasy group, and generally accompanied with snow.

Fortune now smiled on our efforts to penetrate into the unknown regions to the east, for that which most affected us, namely, grass, sprang up like magic. Three varieties of grass only did we find. The coarsest had a sharp point to each blade, and contained comparatively little nourishment, while the finest was found growing usually in rings round the old root, and extremely rich in nutriment. The ponies, as a result of this good feeding, quickly improved in condition, no others dying during the next six weeks. This was fortunate, for their numbers were now reduced to twenty-four.

With every man and animal laden to the utmost, we left Antelope plain on July 27. When first sighting Antelope plain on July 9, not an antelope was then in sight. On July 27 small herds of from ten to twenty were seen tearing across the plain, coming from the north-east, though never more than one hundred were visible at one time. We naturally thought Captain Deasy must have exaggerated when he said that he had seen them in their thousands. However, one march further on, on climbing a ridge to the north of the camp, a marvellous spectacle met our view. As far as the eye could reach to the north and east, and up to our very feet, were tens of thousands of doe antelope and their young. All had their heads turned towards the north-west, and the animals were steadily trekking in that direction. The glasses only revealed fresh numbers arriving on the distant horizon. Many young ones of only a few days old were resting, but they were not allowed to do so for long, for their mothers continually urged them on. They moved either at a hurried walk or gallop. Where had they all come from, and where were they going to? Probably from some safe and now barren breeding-ground to pastures new in the west, where the young grass was growing rapidly. It was a beautiful sight.

Five marches to the east triangulation was commenced in full view of Deasy group and of the well-known peaks of the Kwen Luns. A good base of 1100 feet was measured, and from this one base the whole of the triangulation was done.

We were now camped on a great rolling grassy plain, but vegetation ceased 5 miles to the north of the camp. A rocky ridge running east

and west lay to the south of us, the Kwen Luns to the north, and Deasy group to the west. From this last group of mountains thunderstorms rolled up in rapid succession. These storms were accompanied by hail and snow and terrible squalls of wind, which at times swept us from our feet and lowered the tents to the ground. Theodolite work was carried on with the greatest difficulty; but after a four days' halt the caravan again moved on.

On August 6 we reached the shores of Lake Markham (named after our President), the first view of which I had obtained on July 9 from Deasy group. Lying roughly north-east and south-west, Lake Markham has a length of about 17 miles, a width of from 4 to 5 miles, and an area of 70 square miles. It is regular in shape, and is bounded on the north by low rolling hills, and on the south by a rugged ridge. Its shores are composed of sand and shingle, and its banks shelve slowly. On its waters and along its shores breed in large numbers the Brahmini duck. No fish or shrimps were seen. A river with a strong current runs by many channels into the lake from the west. The water of the lake at its western end is fresh, but as one travels towards the east the water becomes more and more impregnated with salt, until at its eastern end it becomes undrinkable. At the time of our visiting Lake Markham there was no overflow, the surplus water being apparently absorbed by the soil, or lost by evaporation. There is, however, a narrow channel at the eastern extremity, which at this date was very dry, but which bore evidence that at some season of the year the water escapes by this channel and drains into the low-lying ground to the north, which is white with salt.

Leaving Lake Markham behind and travelling due east, we passed over the northern end of a rocky range running north and south. This range was ended by a fine mountain, from the summit of which triangulation work was carried out, a splendid view of the whole country around being obtained. Though the weather continued stormy, and many peaks were hidden by banks of clouds, yet most of the Kwen Luans could be clearly seen, still covered by a field of snow, and giving origin to numerous glaciers, which filled up and occupied the gaps between the more precipitous hills. The country to the north and east appeared a barren waste. To the east the desert plain stretched for 50 miles, only broken by scattered salt lakes and pans, and by rocky knolls and pinnacles rising abruptly here and there. Beyond this again rose low-lying ranges and rolling hills. All around appeared dead; no fresh water, no vegetation, and no animal life—a veritable Dante's Inferno. As the country could be so clearly seen and easily mapped, it only seemed waste of valuable time to continue our march eastward, so our direction was altered to the south.

The ranges here ran north and south, the valleys between being full of low undulating grass-covered hills. The mountains are composed

of limestone, which was much disintegrated. In the valleys deserted gold-diggings were continually seen. None of these were occupied at this time, but several showed by their fresh-water dams that they had been worked quite recently. Wooden bowls for washing gold, bits of cloth, etc., were also found on the deserted camping-grounds.

As we moved south the altitude lessened, the country improved in character, and game again became more plentiful and of greater variety. Yak, antelope, hares, wolves, marmots, ramchickor, and sand-grouse were seen daily. This change was partly accounted for by the marked increase in the number of small streams running from all the mountain-sides. These streams were not only appreciated by the wild animals, but were also welcomed by us, for during the last three weeks it had been necessary for us to dig daily for our water in the beds of the ravines. Generally speaking, we were successful in obtaining water within a few feet of the surface; at other times, however, only a muddy trickle would appear after an hour's steady work; while again, though never for more than two days in succession, our efforts were all in vain, and man and beast slept waterless.

On August 20 the direction was again changed, this time towards the south-west, the caravan following the line of least resistance. The country to the south-east consisted of great salt plains and jagged ranges. In the centre of these plains lay salt lakes, all of which had the appearance of rapid diminution in size. In some places, in fact, only salt pans remained. The low-lying land for several miles round the lakes was void of vegetation, but on the highlands grass grew luxuriantly and game was plentiful.

Three marches further on the caravan arrived on the shores of Huping Tso, a fine sheet of fresh water almost divided into two by a rocky peninsula. The shore on three sides was flat and boggy, while to the south it was bounded by a rocky range, down whose precipitous sides many small streams added their quota to the volume of water. The lake, however, was mainly fed from the distant mountains to the north, upon whose summits snow still lay. The water was absolutely fresh; nevertheless, no wildfowl were to be seen. In the lake weeds and shrimps abounded, but we were unable to see any signs of fish. A broad and sluggish river, flowing from the western end, carried off the superfluous water, which finally drained into the low ground and salt lakes to the south.

Two marches beyond Huping Tso, within sight of the fixed peaks of the Aru Tso mountains, triangulation was brought to a close. At every mountain-top from which theodolite work had been carried out a large cairn of stones was erected, and this, without doubt, conduced largely to the accuracy of the survey. From this point onwards fixed peaks were always in sight, in consequence of which plane-table work was continued uninterruptedly, until the village of

HUPING TSO.

SHEMAI TSO.

Noh, on the Tso me Gualari, was reached. During the month of September the sky remained free from clouds, and the annoying wind ceased to blow. In consequence of this, and as there was now no necessity for ascending the highest peaks, the length of the marches was increased. The direction of our route was still west. Before reaching the lake of Aru Tso, the caravan passed many salt ponds, and finally one small but bitterly salt lake. This lake formed the last vestige of what in olden times was a vast sheet of water, and it had without doubt been connected with Memar Chaka and Aru Tso. The old shores could be distinctly seen high up the mountain-sides. This lake must formerly have had an extent of over 70 square miles. A strong fresh-water stream runs into this salt pond from the south-west. On the banks of this stream the grass grew luxuriantly, and amid this moved great herds of antelope and gazelle.

Aru Tso was reached on August 29. On the shores of the lake the caravan halted, and here a most interesting and also important fact was noticed—the waters were fresh. Captain Bower visited this lake in 1890, camped upon and moved along its shores, and writes, "Like most Tibetan lakes, it is, of course, salt." Captain Deasy reached Aru Tso in 1896, and his report on the water was that it was drinkable—a term which, when used in reference to Tibetan travel, means that the waters are decidedly saline or foul. And now on our journey in 1903, at the end of August, the water was found to be fresh, absolutely fresh, without the slightest trace of salt or disagreeable mineral in it. This is certainly worth recording, if only for the reason that, as this change has been shown to take place in one great lake of the Tibetan plateau, it is quite possible that at certain seasons or periods other lakes may become altered in character. It is to be hoped that in course of time Aru Tso will again be visited, and its water carefully tested.

The caravan passed round the southern end of Aru Tso, crossing an almost endless number of streams, all fordable, but treacherous on account of the quicksands. In the plain to the south and on the slopes of the hills, game was seen in great variety and numbers. Female and young Ovis ammon, bushel, antelope, gazelle, and yak were seen everywhere; the place is a veritable sportsman's paradise. The Aru Tso mountains run north and south for many miles, the western shores of the lake lying close to the foot of the range. These mountains are rugged and precipitous, and their summits are clothed in perpetual snow. The range would be impassable were it not for two cuttings opposite the southern shore of Aru Tso, where two streams have cut their way from the west right through the range. The passage through these openings is easy, as the beds of the streams are almost on a level with the waters of the lake. On debouching from these ravines, both of which were traversed, we met a family of nomads living as usual in coarse cloth yak-hair tents. With them were a herd

of about 1500 sheep and goats, and a few yak. From these people we hired a few of the latter to assist our ponies; but no supplies of food could be obtained, for, except animals, they had no visible food with them; in fact, their first request to us was to know if we had any suttoo to give them. The elder of the two men accompanied us as guide and yak-driver.

Reinforced by this welcome addition of transport, the caravan travelled through an open undulating valley, teeming with wild yak.

On the third day we unexpectedly came upon and halted close to an old Tibetan, who was, together with his son or grandson, living beneath an overhanging rock. These two proved a curious couple, for the old man must have been between sixty and seventy, and the child about five. They were not at all concerned at our sudden appearance, and, after salaaming, continued cooking their meal without more ado. Their repast consisted of wild ass flesh, upon which, together with tea, they declared they had been living for the last six weeks, during which time they had been digging for gold. A pile of earth lay some little way up the river awaiting, for the process of washing the arrival of the remaining members of the family. The child deserves notice if only for the Spartan manner of living. Though only five years of age, flesh formed his only article of diet. He was clothed in a short cotton shirt, which only descended to his thighs. Though the thermometer at night-time registered 18° of frost, yet, on rising the following morning at daybreak, this child was seen in these rags preparing his father's breakfast, and apparently quite insensible to the chilly atmosphere. On the caravan moving off, he refused a mount on a pony, and waded cheerfully through the river, breaking the ice at every step. We had now parted from our late guide, and were handed over to the tender mercies of the old man and his son. The former told us that he had heard early in the season that we were in Tibet; also that the Rudok officials had received full information of our intended journey. The Rudok army (?) had been sent out in all directions, with orders to find us and turn the caravan back. These people had all returned to their homes within a fortnight, after a fruitless search, with the report that we had gone into Chinese Turkestan. Our new guide, therefore, when he saw us, guessed at once that we were this very party, and decided that we had not come to rob him.

For two marches we bore south, traversing an extensive, stony, and almost waterless plain. The mountains on either hand were black in colour, those on the east being covered with snow, whilst immense herds of wild yak were to be seen grazing in all the valleys in this direction. At the south end of the plain, after an easy ascent and a sharp descent through a narrow gorge, the caravan debouched into a long narrow plain, which might almost be termed a valley. The soil of the pass over and through which we had passed was composed of

WILD YAK.

KHEO VALLEY ABOVE NOH VILLAGE.

sandstone, and appeared to be a home of the Tibetan sand-grouse. These birds were so ridiculously tame that even when fired into when on the ground they refused to fly, and continued waddling along quite unconcerned.

The valley we had now entered runs east and west, and deserves more than a passing notice, for it is well known to the Tibetans, and will become much frequented in years to come, since it forms one of the trade routes between Rudok and Lhasa. At its eastern end it is shut off by immense rocky mountains, black in colour, and covered by snow and immense glaciers. The whole northern side of the valley is bounded by a long range of low mountains of sandstone and shale, destitute of water, vegetation, and animal life. Ten miles from the eastern end of the valley the formation of the range bounding the southern side of the plain becomes similar to the northern. In the eastern plain itself and in the mountains near by grass grows luxuriantly, and here game abounds. Great numbers of old fireplaces proved what a favourite spot this is at some seasons of the year for nomads with their herds of sheep and goats. At the time of our visiting it (September 5) no Tibetans were to be seen, probably for the reason, as our guide informed us, that the shepherds were attending a festival near Rudok.

Travelling due west for three marches, the last two of which were along the banks of a fresh-water stream, we reached the shores of Bum Tso. Bum Tso has an area of about 5 square miles. It is a shallow lake, and is surrounded by flat muddy shores. The water is drinkable, but has a distinctly foul flavour. This without doubt results from there being no continuous overflow, though the lake is perpetually fed by the broad stream along which we had been previously travelling. In all probability Bum Tso overflows its banks at some season of the year; otherwise its waters would be salt. Geese, duck, and teal were seen on the water and on the shores in countless thousands, but, on account of the absence of cover and of the depth and softness of the mud, a near approach was found to be very difficult.

When we left this lake behind, a long and trying march carried us over an easy but barren and waterless pass to two fresh-water ponds, and close to a camp of three tents inhabited by Tibetans. Though much frightened at first, these people, nine in number, seeing that we were not a band of robbers, soon made friends, and brought us milk, fuel, etc. We were told by the oldest man that a famous goldfield lay distant 7 miles, on which five hundred labourers were employed. This place we determined to visit the next day for the purpose of obtaining provisions, for we were completely out of all food-stuffs with the exception of meat and tea.

Next morning, however, we were awakened early by an angry harangue outside our tents, and we soon learnt that forty Tibetans, armed with every imaginable weapon, from the gun to the bow and

arrow, had collected to bar our further progress. Persuasion and argument proving useless with them, we ordered the tents to be struck and the march to be resumed. This was apparently the last thing the Tibetans expected us to do, for they did nothing but converse amongst themselves, and, when we moved off, followed about half a mile in rear in a compact group. We advanced likewise in close formation, with the ponies kept well together in the centre. The enemy, however, was continually receiving reinforcements, for men appeared from all directions, springing out of nullahs as if by magic.

The numbers of our opponents soon swelled to between sixty and seventy, but though they closed round us, they could not make up their minds to attack until the arrival of a red lama. I must here mention that though some of our men were carrying carbines and guns, yet before leaving camp Lieut. Hargreaves and I had taken care that they had no ammunition with them, for we were determined that nothing would persuade us to fire unless we were actually fired upon by the Tibetans. This they seemed unwilling to do, but, urged on by the lama, they came to close quarters and tried to seize us. A running fight now ensued, not with guns, but with sticks, butts of rifles, hard knocks being given and returned. The noise was appalling, the Kashmiris, well in the centre and out of harm's way, shouting the loudest. The scrimmage was brought to an end by the Tibetans one and all suddenly dropping their guns and rushing in upon us. We were completely outnumbered, and so were soon in a powerless position, being held firmly by arms and legs. We then smiled upon our enemies and patted them on their backs, a thing which much astonished them and caused them to release us. The ponies, who had stampeded at the noise, and many of whom had fallen and were struggling on the ground beneath their loads, were then collected, and a pow-wow took place. No result was arrived at as to which direction we should proceed, but after two hours' talking it was arranged that we should return to our late camp, and there await the arrival of the headman of the district (who was reported to be on his way), while in their turn the Tibetans agreed to bring us the articles of food we were most in need of.

During the night fresh comers were continually arriving, and with them came the headman. We demanded an apology for having been insulted, and when this had been freely given, the chiefmen were brought into our tent, and the argument began afresh. As stores in the way of suttoo, sheep, ghoor, etc., had been brought during the night, the only thing we had to discuss was as to the route we were to follow. We insisted upon going straight to Rudok, and the Tibetans were determined that we should return by the way we had come. Finally, and after much talk, it was settled that we should move due north straight into the mountains, both parties having conceded an equal amount. We parted that day the best of friends, after having

obtained much valuable information, for they spoke freely on all subjects with the exception of the richness of the goldfields, about which we could learn nothing.

We now entered upon the hardest and most trying part of our journey. The country had originally been a plateau, but was now cut up by endless ravines with precipitous sides of sandstone, broken here and there by slopes of conglomerate. Mighty pinnacles rose in all directions, sometimes to a height of 200 feet or more. Water and vegetation were practically non-existent; nevertheless great herds of bushel were always in sight, living upon nothing so far as we could see. Men and ponies suffered much from the want of water, three of the latter succumbing during the first three days.

Survey work, however, was continued without a break, even under the watchful eyes of the old lama, who had insisted upon accompanying us, much against our wish. This lynx-eyed attendant failed, however, to keep up with Ram Singh and his pony when climbing hills, and we took care to load the riding-pony he had brought, in order to damp his ardour. Astronomical observations were taken nightly without hindrance. The Tibetans never objected to the use of the theodolite, though they showed great dislike to the plane-table. For the purpose of taking observations, we used a subterfuge as practised by Captain Bower in Western China. We showed them the instrument, and explained that it was used for saying our prayers with, and as such, when on its stand, was on no account to be approached by any Tibetans; also that such was its delicacy that not a word was to be said while it was in use. Though the theodolite was used often amongst a large collection of the natives, never once were we disturbed or questioned.

Crossing the dried-up bed of Tatar Tso, the caravan entered a practically waterless valley, bounded on either side by immense precipices, unclimbable by either man or animal. During the next five days we only discovered fresh water twice, whilst grass was conspicuous by its complete absence.

Tai Tso, a series of fresh and salt water pools, was reached on September 18. These ponds were reported by the lama, who had of late constituted himself our guide, to be bitterly salt. Being surrounded by mounds of snow-white chalk and sand having the appearance of salt, this statement at first sight appeared to be correct, but as the waters and shores were covered with geese and duck, we quickly proved that such was not the case. The shores for half a mile all around were entirely covered with the remains of ammonites and fresh-water molluscs. Weeds grew luxuriantly in the water, and amongst these weeds moved myriads of shrimps. All around were thousands of geese, pintails, pochards, and other ducks, while close by a woodcock and a snipe were bagged. A little further on, growing in the hollow of the valleys, were some dwarf shrubs, the first wood we had seen for over

four months. Here hares were met with in great numbers, forty-three being put up within ten minutes. One march beyond Tai Tso our troubles ceased, for we entered into a land of plenty on the banks of the Khio river. This beautiful river poured out from a valley to the east, through meadows of rich short grass. From 30 to 100 yards wide, with a current of 2 miles an hour, it steadily increased in size, being continually fed by springs rising on every side. The bed at times was stony and firm, at others muddy and treacherous, though everywhere weeds grew freely and trout moved fearlessly along.

On September 21 we met more nomads, tending large flocks of goats and sheep. As we very well knew that these people took the information of our approach to the people of Noh, we took the bull by the horns and sent a letter by our lama guide to the Zung of Rudok, with a request for provisions and transport. The following day we were met by a rather truculent band of Tibetans, led, as we afterwards found out, by the bully of the district. They again requested us to turn back, but this time we were determined to have our way, and consequently continued our journey the following day, passing close to, but not entering, the village of Noh, and camping on the banks of the river just beyond. Noh appeared to be a prosperous village containing a population of about five hundred, living in eighty houses substantially built of stone and bricks. There were two monasteries gaily bedecked with linen prayers, coloured rags, and bunches of shrubs. We here received a letter from the Zung of Rudok, saying that he had ordered supplies and transport to be given us. His men, with tsampa, grain, ghi, etc., were camped close at hand, and, I must say, made themselves quite agreeable. We obtained everything we required, though at exorbitant prices, and with the usual endless bargaining of the East.

Many Tibetans accompanied us for two marches to Pal, we will hope simply from friendly motives. The road was a good one and clearly defined; it lay along the shores of Tso Nyak and the twin lakes of Rum Tso. Exquisitely beautiful lakes they are, the water of crystal clearness, in which were myriads of shrimps darting amongst the weeds. The shores were sandy, and the banks firm. Wild rugged mountains rose all around, those beyond Rudok capped with snow. Game birds were plentiful, and the natives reported that the lakes were full of great trout. The Tso Mo Gualari consists of a string of five lakes 120 miles in length, the four most southern of which are fresh, and Pangong, the most northerly, salt. They are joined together by channels about 60 feet in width and 15 feet deep, the current running at nearly 1½ mile an hour. At Pal was another camp guard, placed there to prevent any one entering Rudok district from Ladak.

And now we entered known and accurately mapped districts. The country was barren and inhospitable, but we were again close to British territory, so difficulties and troubles were cheerfully overcome.

On October 3 we crossed the Kien La, 18,600 feet, then once again the Marsi mik La, and camped that night in Ladak. Tankse was reached three days afterwards, and Leh on October 12.

Altogether our travels carried us over 8000 miles of country, the greater part previously quite unknown to the European, while an area of 35,000 square miles was accurately surveyed.

The success of the expedition was mainly due to my staunch and cheery companion, Lieut. Hargreaves; to our ever-willing, hardy, happy-go-lucky Lavaki servants; and to Babu Ram Singh, the sub-surveyor, whose excellent work gained him the title of Rai Sahib.

To Colonel St. G. Gore, late Surveyor-General of India, to Mr. Eccles, of the Survey of India, and to Major Ray, Intelligence Branch, who most kindly gave us every assistance and advice, I take this opportunity of tendering our sincerest thanks.

PTOLEMY'S MAP OF ASIA MINOR: METHOD OF CONSTRUCTION.

By the Rev. H. S. CRONIN.

The first condition of any study of Ptolemy's map is to disabuse our minds completely of the notion that we have in it a map which is accurate according to modern conceptions of accuracy, or which was constructed on modern lines. Such map-making, indeed, was beyond the means at Ptolemy's disposal—he had but few observations, none of those he had were strictly accurate, and he had no means of taking better ones. In any case, his map is not accurate. It is far too large. The distance from Issus to Rhodes should be 420 miles. Ptolemy makes it nearly 500. The distance from Rhodes to Chalcedon should be about 300 miles; he makes it over 400. Initial errors, so considerable as these, make themselves felt everywhere. They affect, for instance, the area; it is fully half the size again it ought to be. They affect the boundaries. Rhodes and Chalcedon being 100 miles too far apart, the whole western coast between the two has been pulled in towards the east. Ptolemy's western coast of the Troad is therefore about 70 miles from the line joining Rhodes and Chalcedon; it should be twice that distance. Again, this removal eastwards of the western coast has led to compression all along its course. Ptolemy's Cyzicus, for instance, is some 50 miles from his Nicæa—it should be 96 or 97—while the towns along the road which joins them are huddled together. Turning to the other boundaries, the northern is distorted, the southern is far too straight, and the eastern boundary for much of its course runs due north and south. In the interior of the map, places tend to move towards the centre. Compare, for instance, the positions of Laodicea, Antioch, and Amorium on Ptolemy's map and in reality.* All this had to be to fill the map, and, without going into further details, we may note that the first principal and constant cause of Ptolemy's mistakes is this initial mistake, however he arrived at it, of making the area of Asia Minor so very much too big.

The second principal cause was the insufficiency and vagueness of the bulk of

* Cotiæum is an exception only in appearance. It has moved south and east, but the western coast was also moving east.

the information, as much about the coast as about the interior, which he had at his disposal. He had an observation for Rhodes, which, if not strictly correct, may be allowed to pass. It is not so with his observations—if he had them; and I half incline to think he had—for the latitude of Smyrna, the Hellespont, Byzantium, Issus, and Trapezus. These are out, some of them very much out. To discuss the reasons, which led him to put these places where he did, would lead us too far from our subject. We should have to take into consideration facts, or supposed facts, outside Asia Minor which contributed to fix their position. It simplifies our problem to assume—and it is a fair assumption to make from the prominence, and the kind of prominence, Ptolemy gives to these localities, and it is probable enough in itself—that, when he left the map of the world and settled down to construct the special map of Asia Minor, the situation of these places had been fixed to his satisfaction, if not to ours; this assumption is made practical certainty by an examination of his map. Other observations, as far as we know, he had none. On the contrary, he had sometimes to rely merely on travellers' notes, often vague as to distance, and even vaguer as to bearing; the vaguest being that such and such a place was so many hours or days from such another place, or lay towards the north or the south. Vague and unsatisfactory by land, winds and currents would make these indications still less trustworthy by sea; and though Ptolemy claims that sea-coast towns are easier to place than inland towns, because their position relative to each other can be more easily shown, he does not find them very tractable. Precise indications of bearing there would be none; precise indications of distance would be found in practice only along the Roman roads; and even these roads, accurate as the information which they give may be, so far as it goes, afford no clue to the bearing of place from place, or to the allowance which had to be made for windings. These two things, then, were against internal accuracy. The area of the map was very much too large; the materials for constructing it—even the best of them—lacked completeness. The first drove Ptolemy to treat his materials in an arbitrary manner; the second, if it did not actually tempt to such treatment, could present no serious obstacles to its adoption.

Arbitrary, however, as many of his results appear, no one could have more desire than Ptolemy to treat his materials fairly, and no one could be more conscious of his lack of material, or of the disturbing effect this lack must have on his results. Arbitrary, indeed, is hardly the word to apply to Ptolemy, for it is clear that he had a method, and, considering everything, a good one. His materials are at fault; and if they are partly responsible for the defects of his method, no method, however good, could have eliminated confusion altogether from results built on information never complete and often contradictory.

The publication in 1901 of the second part of the first volume of Müller's 'Ptolemy' has made the task before us considerably easier now than it was three years ago, but great difficulties still remain.* Accuracy of transmission, always difficult to secure where copyists are concerned, is particularly difficult in the case of figures. We cannot, therefore, be certain always that we have the right reading. Recent exploration has done much to fix the sites of the more important towns, but some still remain uncertain; and we are still without definite information as to the length and course of the roads which joined some of those towns, the sites of which are definitely ascertained. Yet we now know something for our

* I have adopted Müller's readings throughout, and as a rule his spelling. The information he has collected in his notes has often been of considerable service to me; so, also, have been his maps in the preparation of the maps which accompany this article. The work, which is published at Paris by Firmin-Didot, was left incomplete at Müller's death, and is being continued by Fischer.

purpose, especially if we bear in mind that Ptolemy's map does not aim at precise accuracy, and that positions on it are indicated by twelfths of degrees—that is to say, only within 4 or 5 miles.*

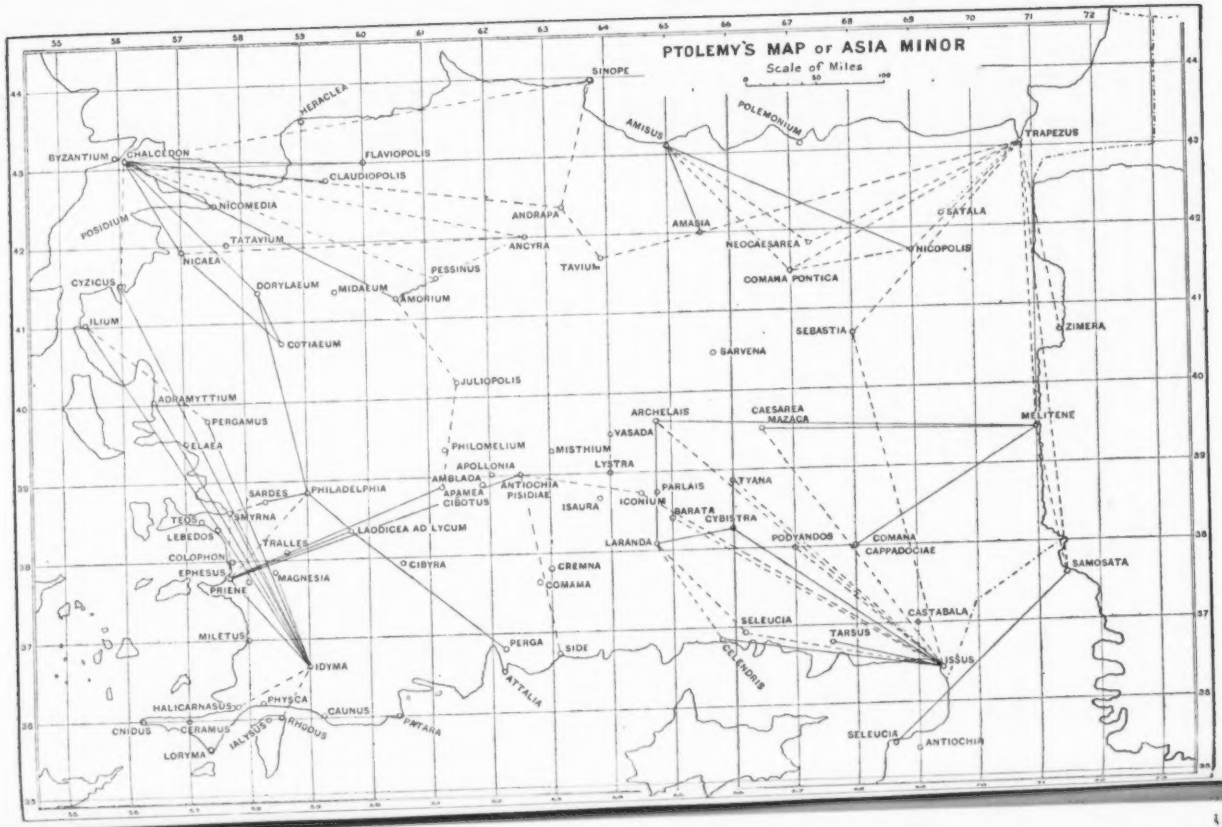
Our best plan now will be to take a map constructed from Ptolemy's figures, and to see what that can tell us of his method, or of his lack of method, in constructing it, and to begin its examination from Rhodes—that is to say, from the south-west corner of the map—working from thence up the western coast. The south-west corner is characteristic of Ptolemy and his difficulties—I believe, also, of his methods. Rhodes figures largely in Ptolemy's introduction, and is for that reason, as well as for others, a natural place from which to begin, while the outline of the coast, or at all events the positions of the more important sites along the coast, would have to be determined before the task of fixing the positions of places inland could be approached.†

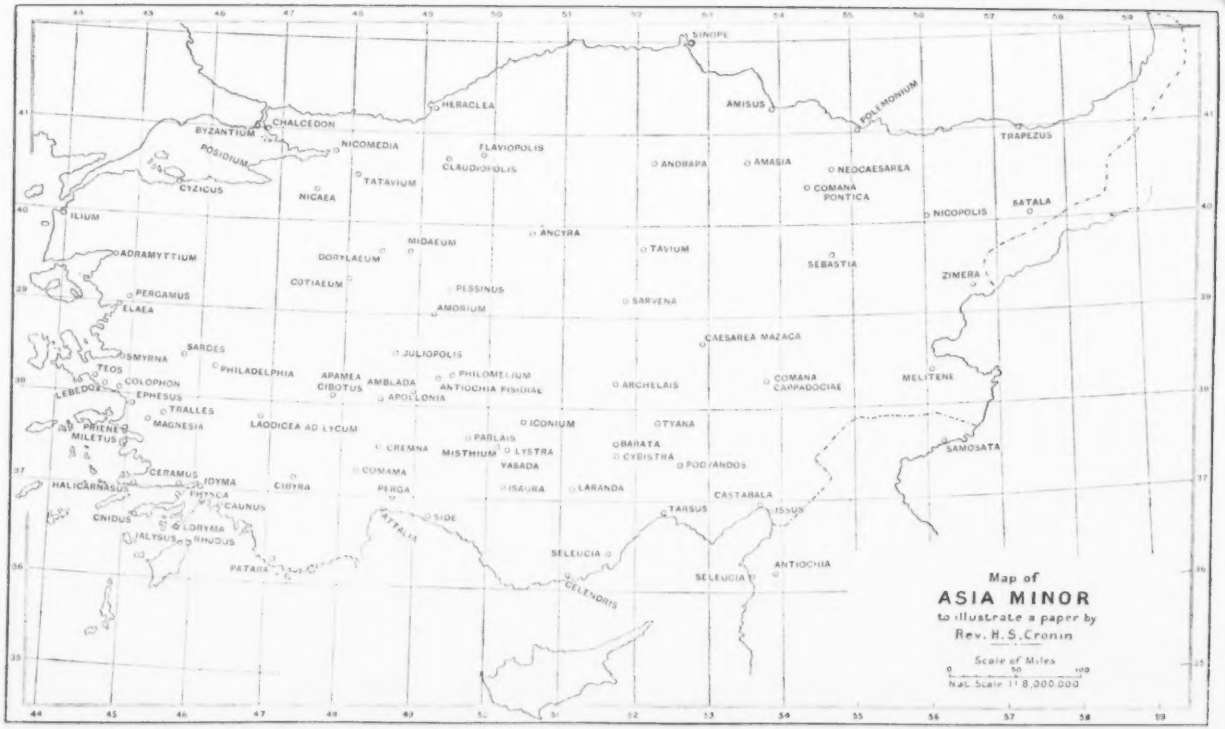
Travellers going north from Rhodes would land at Physca (or Physcus), whence a road led to Ephesus by Idyma (or Idymus), Tralles, and Magnesia. Physca lies almost north of Rhodes, at a distance of 30 miles. Ptolemy places it almost north-west, and at a distance of 23, an error of 7 miles in distance, and of half a right angle in bearing. I have, however, just pointed out that Ptolemy's unit is a twelfth of a degree, so that the 23 miles may represent as much as 28; probably in this case it does represent as much as 25 or 26. Moreover, when I said that the distance from Rhodes to Physca was 30 miles, I meant that that *is* the distance according to modern maps; I did not mean Ptolemy knew that it was such. A successor, indeed, of Ptolemy makes it 28, and as distances at sea were hard to estimate, there were probably other estimates placing it even lower. Now, just because sea-distances were hard to estimate, any such estimate, when obtained, would be the less convincing, and accordingly the less able to resist the claims to consideration of other and conflicting *data*, when such existed. In the south-west corner of Asia Minor such claims do exist in considerable force. A comparison of the two maps will show how much the coast winds; that Ptolemy had no exact information of its windings, and that, as he practically ignores them and makes the coast-line nearly straight, he gets into great difficulties. Loryma and Cnidus are, for instance, far from where they ought to be; and the length of the south coast west of Physca is such that, if its windings are neglected, the proper northern coast is not long enough to match it. Ceramus has been carried west of Halicarnasus; Idyma, to which we shall return shortly, is made apparently an inland town, 58 miles (or roughly its right distance from Halicarnasus) from the sea. To put it briefly, the course of the whole coast-line has been changed, and the Ceramic gulf more or less suppressed.‡ In such circumstances—and I can only sketch them

* For the special maps, Ptolemy treated both meridians and parallels as parallel and straight lines. His degree was 500 stades, or approximately 58 English miles; the proportion of a degree of latitude to one of longitude in the map of Asia Minor was 4 to 3 (Ptolemy, 'Geographia,' **2**, 1, § 9; **8**, 2, § 6 and ad πιν. Ασ. ά). The minimum margin, therefore, would be a little under 4 miles measuring from east to west, and *vice versâ;* the maximum, along a diagonal, a trifle over 6. Ptolemy may have chosen either the corner of the parallelogram nearest to where his *data* placed the town, or, perhaps, the most convenient.

† The position of Rhodes is not given in Book V. of Ptolemy's 'Geography;' for some reason or other it has fallen out. Its position, however, can be recovered from the eighth book, and it is 58° 40′, 36° (cf. Müller, p. 838; Book VIII. is not yet published).

‡ Mr. J. L. Myres, who has kindly made many useful suggestions to me on the subject of this paper, tells me that native sailors try to avoid the Ceramic gulf. Is the opening marked in the Peutinger table between Myndus and Cnidus the Ceramic gulf, such as Ptolemy perhaps conceived it, or the Meander, which is not represented in its proper place?


PTOLEMY'S MAP OF ASIA MINOR
Scale of Miles
SINOPE
HERACLEA
AMISUS
POLEMONIUM
TRAPEZUS
BYZANTIUM
CHALCEDON
FLAVIOPOLIS
CLAUDIOPOLIS
NICOMEDIA
POSIDIUM
ANDRAPA
AMASIA
SATALA
TATAVIUM
NICAEA
ANCYRA
TAVIUM
NEOCAESAREA
NICOPOLIS
CYZICUS
DORYLAEUM
MIDAEUM
PESSINUS
AMORIUM
COMANA PONTICA
ILIUM
COTIAEUM
SEBASTIA
ZIMERA
SARVENA
JULIOPOLIS
ADRAMYTTIUM
PERGAMUS
ARCHELAIS
CAESAREA MAZACA
MELITENE
ELAEA
PHILOMELIUM
MISTHIUM
VASADA
APOLLONIA
LYSTRA
AMBLADA
ANTIOCHIA PISIDIAE
PARLAIS
TYANA
SARDES
PHILADELPHIA
APAMEA CIBOTUS
ISAURA
ICONIUM
BARATA
CYBISTRA
TROS
SMYRNA
LEBEDOS
LAODICEA AD LYCUM
LARANDA
PODYANDOS
COMANA CAPPADOCIAE
TRALLES
COLOPHON
CIBYRA
CREMNA
SAMOSATA
EPHESUS
MAGNESIA
PRIENE
COMAMA
SELEUCIA
CASTABALA
MILETUS
PERGA
SIDE
TARSUS
CELENDRIS
ISSUS
DIDYMA
ATTALIA
HALICARNASSUS
PHYSCA
CAUNUS
CNIDUS
CERAMUS
IALYSUS
RHODUS
PATARA
SELEUCIA
ANTIOCHIA
LORYMA


SINOPE
HERACLEA
AMISUS
POLEMONIUM
TRAPEZUS
CHALCEDON
BYZANTIUM
NICOMEDIA
FLAVIOPOLIS
POSIDIUM
CLAUDIOPOLIS
ANDRAPA
AMASIA
NEOCAESAREA
TATAVIUM
CYZICUS
NICAEA
COMANA PONTICA
SATALA
NICOPOLIS
ILIUM
ANCYRA
MIDAEUM
TAVIUM
ADRAMYTTIUM
DORYLAEUM
SEBASTIA
ZIMERA
COTIAEUM
PESSINUS
PERGAMUS
SARVENA
ELAEA
AMORIUM
CAESAREA MAZACA
SARDES
JULIOPOLIS
SMYRNA
PHILADELPHIA
APAMEA CIBOTUS
AMBLADA
PHILOMELIUM
ANTIOCHIA FISIDIAE
ARCHELAIS
COMANA CAPPADOCIAE
MELITENE
TEOS
COLOPHON
APOLLONIA
LEBEDOS
EPHESUS
TRALLES
ICONIUM
TYANA
MAGNESIA
LAODICEA AD LYCUM
PRIENE
PARLAIS
BARATA
SAMOSATA
MILETUS
CREMNA
MISTHIUM
LYSTRA
CYBISTRA
YASADA
PODYANDOS
CERAMUS
IDYMA
COMAMA
HALICARNASSUS
CIBYRA
PERGA
ISAURA
LARANDA
CASTABALA
PHYSCA
CAUNUS
TARSUS
ISSUS
CNIDUS
SIDE
LORYMA
IALYSUS
RHODUS
SELEUCIA
ANTIOCHIA
PATARA
SELEUCIA
CELENDRIS
Map of
ASIA MINOR
to illustrate a paper by
Rev. H. S. Cronin
Scale of Miles
0 50 100
Nat. Scale 1 : 8,000,000

now—Ptolemy would be glad to place Physca as far east as possible, and of two estimates of its distance from Rhodes would choose the shorter. The proceeding might be desperate for us; unhampered, as he was, by too accurate knowledge, it was a natural expedient for him.

Suppose, then, we take Ptolemy's map, place one point of a pair of compasses on Rhodes and the other point on Physca, turn the second point round until it rests on the line joining Rhodes and Idyma, and measure the distance between it and Idyma; we shall find that it measures 15 miles. The site assigned to Idyma is Guiova, at the head of the Ceramic gulf, and the distance of Guiova from Marmario (Physca) is 14 or 15 miles, the distance we have just obtained.* Idyma, then, is, I do not say the right distance from Rhodes, but the distance which Ptolemy apparently thought Physca was from Rhodes, *plus* the right distance from Physca to Idyma by land.† Its insular position prevented Rhodes from serving as a general centre of measurement for the mainland. Physca, the port for Rhodes on the mainland, would be its natural representative; it was, however, not available for such a purpose—the claims of the south coast had carried it too far west—and it is not so used. Idyma, on the other hand, the next town along the road to Ephesus, and a town away from the southern coast, was available, and measurements from it yield some interesting results.

The first places on the west coast to be fixed would be Ephesus, Smyrna, Adramyttium, Ilium, and Cyzicus. Ptolemy's map-distances for these places from Idyma are 87, 129, 221, 296, and 304 miles respectively. Placing Idyma at Guiova, and measuring the distance by road to Ephesus, and then on, we get, as nearly as I can calculate, the following results: Idyma to Ephesus, 84½ miles; Idyma to Smyrna, 125 or 126; to Adramyttium, 224; to Ilium, 300; to Cyzicus, 300; that is to say, the map-distance is sometimes 2 or 3 miles too much, sometimes 2 or 3 miles too little—it is never out a twelfth of a degree. Such correspondence is not true of every place along the coast, and between these distances and the air-distances there is no correspondence at all. In spite, therefore, of the risk there must be of slight error in calculations of this sort, it would not be rash to say provisionally that these five places had been specially picked out—reasons for their selection would not be hard to find—that their positions had been fixed partly by their road-distances from Idyma, as representing Rhodes, and that no allowance was made for windings, although, as it is very much to our purpose to observe, the road winds a great deal. I shall return to this point later. Suppose, however, this were done, Smyrna would be where a circle with Idyma as centre and the road-distance from Idyma as radius cut the parallel of Smyrna; the parallel of the Hellespont would fix the site of Ilium; while Cyzicus would be fixed by its sea-distance from Byzantium, a distance apparently measured by Posidium, and not too much to be trusted.‡

The position Ptolemy assigns to Ephesus is instructive. He places it 53 miles due south of Smyrna. The correct position is 37 miles a little east of south; the

---

* It is not unusual, as we shall see later, for Ptolemy to calculate the distance of A from B *viâ* C, and then, if necessary, to place C right away from the line which joins A and B.

† Land-distances were more easily measured and not so easily adjusted. Idyma has approximately the right bearing from Rhodes. The road from Physca to Idyma is nearly direct.

‡ It would not be difficult in any of these cases to choose between the two points where the circles, or the circles and parallels, intersected. Elsewhere it has been less easy, and mistakes have led to great confusion.

road-distance is 41 English miles, which corresponds, as nearly as we can expect, considering the way the map was made, with the difference in the map-distances of Smyrna and Ephesus respectively from Idyma. But though Ptolemy seems to know the distance and to use it when it suits, he also disregards it when it suits. He could not place Ephesus on the line joining Smyrna and Idyma—it would be too far east. He could not, if my hypothesis is true, go back on his measurements from Idyma, and place Smyrna further south or Ephesus further north. Moreover, if the whole western coast was to be pulled out, the coast-line between Smyrna and Ephesus would have to do its share. To do as he did was obvious; probably on the whole his solution was not so very inconsistent with his facts, especially as the coast road* would give him most of the statistics he required to justify his action. We have here both the effect of the influence of the initial error, and another instance of the practice to which I have already called attention, in the case of Rhodes, Physca, and Idyma, of measuring from A to B *viâ* C, and placing C right off the line which joins the two.

As we are at Ephesus, we may as well discuss the evidence of the trade-route, and therewith the question of the way in which Ptolemy dealt with the interior. Magnesia is some 14 miles from Ephesus, and lies south-east; Ptolemy places it 40 miles away and slightly north of east. Tralles is 28 miles from Ephesus, and lies east-south-east; Ptolemy makes the distance 50 miles, and the bearing nearly north-east. So far no method is apparent, but when we take the principal road-centres along the road—Laodicea-ad-Lycum, Apamea Cibotus, and Antioch—we find the road-distances agree as closely with the map-distances as they did in the cases examined on the western coast. The inference again is that the roads were used, that they were treated as straight lines, and that, as we might expect, the chief road-centres were fixed first. The trade-route, or its continuation, gave one clue; measurements from Perga in the case of Laodicea, measurements from Side in the case of Antioch—again the map-distances and road-distances practically agree—would give the other.

Now, with regard to his treatment of these roads, it is natural enough that Ptolemy should use the valuable information they afforded; it would be unreasonable to expect detailed acquaintance with their windings, but the apparent absence of all knowledge that they did wind—at least no indication thereof in practice—is hard to understand.† But suppose he had been able to ascertain the correct air-distance, say, to Laodicea from the coast, suppose he had fixed its position accordingly, and suppose he could have done the same for other places, what would have happened? Every place which occupies the centre of his map would have moved by so much towards the coast, and would have left a space in the middle of the map roughly 100 miles wide by 300 miles long without a town in it at all.‡ What else, then,

---

* For much of his perimeter *data*, Ptolemy would depend also on the track of a circumnavigating vessel.

† Ptolemy is, as a matter of fact, aware of what he was doing, and speaks with regret (Bk. i. 2) of his ignorance of the windings of the roads. Would anything else, however, have served his purpose and led, on the whole, to better results, except a knowledge of details altogether beyond his reach? Would, moreover, the extent of error, introduced by the neglect of the windings, be as obvious to an Egyptian as to a native of a mountainous country? Roman roads, moreover, are straight, and Ptolemy was a geometrician rather than a traveller. Since writing the above, I have come across two passages in Bunbury ('History of Ancient Geography,' **2**, p. 27, and **1**, p. 642) which bear on this question (cf. Bunbury, *op. cit.*, **2**, p. 27).

‡ The same, albeit perhaps to a less extent, would have happened if a fixed allowance had been made for windings.

could he do, in order to do justice to all his facts, but place Laodicea as far from Ephesus as his information made possible, and, *mutatis mutandis*, treat other selected places in the same way? With regard to intermediate places, Magnesia, for instance, or Tralles, he would naturally deal with them later, and to be consistent, he ought to have placed them at their proper distances along the line joining the two road-centres between which they came—*i.e.* to take the case before us, on the line joining Ephesus and Laodicea. This, at all events, he does not do. The road gives him the distance from centre to centre. He recognizes its existence afterwards to this extent only—he places intermediate towns at more or less appropriate distances about its course; but otherwise its direct course is ignored. The positions of these latter towns are determined on no fixed principle. Sometimes Ptolemy was guided by their distance from one or other of his centres; sometimes by the distance between place and place; sometimes, it must be confessed, by the effect produced on the general appearance of his map. The district, for instance, which we are considering, lying as it does towards the west, has been influenced by the course Ptolemy has assigned to the western coast; various western towns are therefore too much to the east, and have usurped positions which belong to other places. Priene, for example, is, relatively to Ephesus, almost where Magnesia ought to be. In other words, results already obtained demanded that freedom of handling which Ptolemy's materials tolerated, and made him glad to avail himself of reasons for moving Magnesia and other places also to the east. Measurements from Ephesus were unmanageable, and were ignored in favour of others, so that we find that, within the usual limits, Magnesia is its right road-distance from Idyma, as well as from Tralles, which, in its turn, appears to go back through a series of windings to Laodicea.

It appears to me most natural that in his treatment of the roads Ptolemy should adopt the method I have described; any other method—he probably tried others—would have led to trouble. Its naturalness is a great presumption in its favour. Nor are proofs of its adoption lacking; I have already given several instances. I have indicated on the map by lines certain others which I consider likely, dotted lines, as a rule, denoting those measurements of which I have a little doubt, or for which the *data* are not quite satisfactory. The instances could be increased, but, allowing for an occasional desertion—and the risk of error in measurements and calculations of this kind must not be overlooked—they are, I think, sufficient in number to make my hypothesis exceedingly probable. The evidence, moreover, afforded by such general correspondence between map-distance and road-distance for road-centres along main roads, must be taken in conjunction with the absence of similar phenomena where, on my hypothesis, it would not be expected.

The authorities on which these measurements are based are most conveniently given in an appendix (see p. 438); a few points, however, which arise from an examination of the map require notice here.* We should have expected the triangulation of the map to have been built up from Rhodes, or rather from a base measured from Rhodes. As a matter of fact, for the interior there were four main centres of triangulation, and four independent systems—Idyma, the representative of Rhodes, Chalcedon, the representative of Byzantium, Trapezus, and Issus being the centres respectively for the south-west, north-west, north-east, and south-east systems. Though sea-coast towns, Ephesus, for instance, notably, and Amisus, are used in the triangulation, or inland towns, such as Melitene, they ultimately derive their position from one or other of the corners of the square. The independence of the

* The note will bring out, also, how great the difficulty often is in arriving at an absolutely correct estimate of the distance of one place from another.

systems is clear from several considerations. In the first place, map-distances and road-distances, measured from sites belonging to a given system to the centre appropriate to that system, are found to coincide. In the second, when similar measurements are made to a centre belonging to another system, no such correspondence can be traced. In the third, as we shall see, towns in the centre of the map are often either too close together or too far apart. It is interesting to note that in measurements from Trapezus, which pass through Satala, the distance between the two given by Marinus—60 m.p.—is retained. Ptolemy's censure applies only to the latitude assigned to Satala.* I was led to this conclusion by observing that the measurements, Trapezus to Nicopolis, Trapezus to Sebastia, etc, were, on any other condition, out by a uniform amount. A site once fixed was available for fixing the position of another site more in the interior or off a direct road from the coast. Thus the position of Philadelphia is fixed from Laodicea and from Ephesus, and itself affords one clue to the position of Dorylæum.†

It is towards the middle of the map that Ptolemy's method breaks down. On the one hand, the eastern and western systems tend to overlap, on the other the northern and the southern refuse to meet. The first is conspicuous in the case of Tavium and Ancyra, the second in the case of Tavium and Cæsarea. The position of Ancyra was fixed from the north and west,‡ that of Tavium from the north and east. In spite of Ptolemy's initial error, Chalcedon and Trapezus were still too close together to allow the windings of the roads to be ignored completely. Tavium and Ancyra, the border towns of the two systems, are therefore not far enough apart—not by a third of their proper distance. The road which joins them is, accordingly, represented on the map with exaggerated windings. The position of Cæsarea Mazaca, on the other hand, was fixed from south and east, and Ptolemy's method, neutralized to some extent by the fact that it pushed Tavium west as well as south, failed to catch the distance up. Tavium and Cæsarea should be about 100 miles apart: Ptolemy could not make them less than 170. The direct road which joins the two had therefore to be dropped; but a *détour* was available, which figures, more or less, in the Peutinger Table, and measures, according to that authority, 191 Roman miles.§ With the help of Ptolemy's map it appears

* 'Geographia,' lib. i. c. 15. The distance on Ptolemy's map is 83 English miles.

† The distance from Ephesus to Philadelphia is measured by Hypæpa and Sardes. It is interesting to note that the distance from Ephesus to Sardes *viâ* Smyrna agrees with the map-distance also measured *viâ* Smyrna, the map-distance from Ephesus to Smyrna being as much too great as the distance from Smyrna to Sardes is too small. This method of compensation is not without parallel in Ptolemy, and it had to be here no account of the course of the western coast.

‡ On the whole, I am inclined to think that Ancyra was fixed from Amorium, a secondary base, and Sinope, but distances are uncertain.

§ To Ptolemy, however, a road was chiefly a means of ascertaining the distance of one place from another; it was not, except incidentally, a means of journeying from place to place. It is, therefore, hardly right to say that the road is represented on the map, or that a *détour* was available. What, I imagine, Ptolemy did was this. Being in a difficulty, he fixed the position of some place accessible from both—perhaps it was Sarvena—from Tavium and Cæsarea by the help of its road-distances, not necessarily direct, from those places. This place and Tavium (or this place and Cæsarea) gave the clues to intermediate places, and kept them somewhere near the line joining the two. Where, on the other hand, there was compression—for instance, between Cyzicus and Nicæa, or between Ancyra and Tavium—it was convenient to measure from place to place along the road. Allowance, however, has to be made in such cases for Ptolemy's standard of accuracy, and for the consideration with which we deal in the next paragraph.

direct. Many of the towns mentioned in the table are scattered at appropriate distances about the line which joins the two.

Ptolemy's system of constructing his map by means of the intersection of circles gave two points for the position of each site. Between the two Ptolemy had to make his choice, and he was guided to make it by general considerations and by previous results. The point he did not choose, for instance, for Smyrna would be too far east; the point he did not choose for Nicopolis would be in the Euxine sea. These cases were straightforward, but even where our fuller knowledge shows him to be very wrong, his choice was never altogether inconsistent with the knowledge he possessed, and was required by the results he had already obtained. The district south-east of the Pisidian Antioch is from this point of view one of the greatest interest. Iconium, indeed, is approximately its right distance from Antioch, but while Lystra is north of the line joining the two instead of south, Vasada and Amblada, which should be nearly south of Antioch,* are placed relatively to that city, the one as much north of east as the other is south of west; Parlais, which probably should be at Beysheher, has been removed east of Iconium, and Misthium has been carried from the position now assigned to it to a distance from Pappa the same as now, but a little west of north instead of west of south. What has happened is, I venture to suggest, as follows: Antioch is, on Ptolemy's map, too far from the south coast; the western group of colonies, which depended on it, have therefore been carried east, so much so that Cremna is 8 or 9 miles east of the line joining Antioch and Side instead of about 40 miles west of it. They and the towns immediately east of them accordingly occupy the ground which from the latest results ought to have received Lystra, Vasada, and the other towns I have mentioned. These could not be also carried east—the towns of the south-eastern system, to which Iconium and probably Isaura belonged, prevented that—so they have been squeezed out between the two groups. Lystra has suffered least. It is still approximately its right distance from Pappa and Iconium, and the relative positions of the three would not be so very far out, if the southern point of intersection of the circles had determined its site, and still less, if the site of Pappa had been fixed from Iconium, instead of from Antioch. With regard to the other places, the geography of the locality is too uncertain to justify at present an attempt to discover Ptolemy's mode of dealing with them, but experiments with various centres of measurement—Vasada, for instance, is its right distance from Antioch—appear to promise with fuller knowledge results similar to those obtained with Lystra.

APPENDIX.

Tables of Distances and Authorities employed.

In this Appendix the following abbreviations have been used:—

M. = Charles Müller, 'Claudii Ptolemæi Geographia.'
H. G. = W. M. Ramsay, 'The Historical Geography of Asia Minor.'
C. B. = W. M. Ramsay, 'Cities and Bishoprics of Phrygia.'
F. = the French map of Asia Minor.
K. = H. Kiepert's map of Asia Minor.
St. = J. R. Sterrett, 'Wolfe Expedition,' and 'Epigraphical Journey in Asia Minor,' vols. 2 and 3 of the Journal of the American School at Athens.
P. = the Peutinger Table.

* Cf. Ramsay, "Pisidia and the Lycaonian Frontier," in the Annual of the British School of Athens, No. ix. I gladly take this opportunity of acknowledging the many obligations under which I am to Prof. Ramsay. Some of them will be clear from the note which follows, but the note cannot show but a very small proportion of them.

The handbooks referred to are either Murray's 'Handbook to Constantinople' or Murray's 'Handbook to Asia Minor.' The measurements were made on a map specially constructed. The size of the maps which accompany this article makes them unsuitable for such a purpose; they are, in fact, merely convenient means of indicating results obtained by other means. I shall be glad to receive any corrections, of the probable need of which I am most conscious, and to facilitate them I have given references, and endeavoured to indicate how I arrived at my results. It is, however, the general coherence and naturalness of the method here suggested which appealed to me. Until my results have been tested, it is premature to discuss the use which can be made of them; but it appeared to me, as I was engaged on this work, that, if they stand the test, Ptolemy's information would be available, more than heretofore, to fix or suggest the sites of towns and the courses of the roads. They might also increase, for the same purpose, the value of the Table and the Itineraries.

I. Measurements from Idymus.

	Map-distance.	Road-distance.
Idymus to Ephesus	87	84½
„ Smyrna	129	125 or 126
„ Adramyttium ...	221	224 or 225
„ Ilium	296	300
„ Cyzicus	304	300
„ Magnesia	73	72
„ Pergamus	190	189 or 190

Idymus to Tralles, 56 miles (M., p. 815, F. K.); Tralles to Ephesus, 28½ miles (H. G., p. 164); Ephesus to Smyrna, 40 or 41 miles (H. G., p. 165); Smyrna to Pergamus, 63 miles (H. G., p. 165); Pergamus to Adramyttium, 35 miles (H. G., p. 166, note, F.); Adramyttium to Ilium, 75 miles (H. G., p. 166, note, gives Adramyttium to Assos, 41 miles; F. gives 33 or 34 miles on; cf. Murray's Handbook (Asia Minor), p. 63, and Peutinger table); the French map gives a distance in a direct line of approximately 72 miles from Adramit to the ruins of Cyzicus; the direct distance from Bergamo is 100 miles in the Handbook.

II. Measurements from Ephesus.

	Map-distance.	Road-distance.
Ephesus to Laodicea-ad-Lycum ...	97	100
„ Apamea Cibotus ...	167	164
„ Antiochia Pisidiæ ...	225	225
„ Philadelphia (*viâ* Smyrna)	115	112
„ „ (*viâ* Hypæpa)	81	82
Perga to Laodicea	140	139
Laodicea to Philadelphia	46	45
Side to Antiochia	130	128
Philadelphia to Dorylæum	148	150

Ephesus to Laodicea and Apamea (C. B., pp. 748 and 170; cf. H. G., p. 164); Apamea to Antioch (St. map); Ephesus to Philadelphia (*viâ* Smyrna and Sardis, H. G., p. 167; *viâ* Hypæpa, *ib.*); Perga to Laodicea (C. B., p. 255); Side to Antiochia (St. map); Laodicea to Philadelphia (H. G., p. 167); Philadelphia to Dorylæum (H. G., p. 168).

III. Measurements from Chalcedon.

	Map-distance.	Road-distance.
Chalcedon to Nicæa	74	74
„ Dorylæum ...	133	137
„ Amorium ...	219 or 220	217
„ Pessinus ...	239	235

The distance from Chalcedon to Nicæa was not measured by Nicomedia, but probably by the ferry at Cibotus. The distance given in Murray's Handbook (Constantinople) for this route corresponds very closely to the distance on the map, namely, Haidar Pacha to Dil Iskelesi, 34½ miles; Ferry, 2 miles; Hersek to Isnik, fifteen hours, say 38 miles (cf. pp. 116, 132, and H. G., pp. 186, 188, and 240 ff.). Nicæa to Dorylæum, 63 miles (Peutinger, M., p. 804, R.G. map); Dorylæum to Tricomia, 42 miles (H. G., p. 239); Tricomia to Amorium, 38 or 39 miles (H. G. map); Amorium to Pessinus, 27 miles (H. G., p. 237); Dorylæum to Pessinus, 62 miles.

The distances to Ancyra are perplexing, and the problem cannot be settled without fuller information than I possess. It is worth while, however, to note that the distance from Amorium to Ancyra is on the map 100 miles, or within a mile or two of the correct road distance (H. G., p. 238). The map-distances from Chalcedon to Claudiopolis and Flaviopolis respectively also agree with the distances by road as given on Ramsay's map. I am inclined to think now that both Pessinus and Ancyra were fixed from Amorium.

IV. Measurements from Trapezus and Amisus.

	Map-distance.	Road-distance.
Trapezus to Nicopolis ...	112	110
„ Neo-Cæsarea ...	169	170
„ Comana Pontica	189	189
„ Amasia	243	243
„ Sebastia ...	185	185
„ Tavium	320	324
Amisus to Amasia	64	60
„ Neo-Cæsarea ...	123	133
„ Nicopolis	188	185
„ Comana Pontica ...	123	115

Trapezus to Satala, 54 miles (M., p. 41); Satala to Nicopolis, 56 miles (K. cf. H. G., map); Nicopolis to Neo-Cæsarea, say 60 miles (H. G. map, and Murray's Handbook of Asia Minor, map and pp. 44 ff.); Niksar to Koilu-hissar is 19 hours, say 50 miles, and it is about 10 miles on to Purkh; Neo-Cæsarea to Comana Pontica, 19 miles (H. G., p. 263); Nicopolis to Sebastia, 75 miles (M., p. 875); Neo-Cæsarea to Amasia, 73 miles (H. G., p. 263); Amasia to Tavium, 81 miles (H. G., p. 260); Amisus to Amasia is 24 hours, say 60 miles. Kiepert makes the distance from Amasia to Neo-Cæsarea less, and that to Comana more.

V. Measurements from Melitene.

	Map-distance.	Road-distance.
Melitene to Cæsarea Mazaca ...	198	200
„ Comana Cappadociæ	153	155
„ Archelais	275	272
„ Samosata	115	115

The authorities for these statements are H. G., p. 273 (cf. Sterrett, 'Epigraphical Journey in Asia Minor,' p. 234 ff. and map), and C. B., p. 749; the distance from Melitene to Samosata is given in M., p. 892, as 115 miles.

The distance from Trapezus to Melitene corresponds approximately with the measurements on Kiepert's map—54 miles being allowed for the distance between Trapezus and Satala, and the route *viâ* Aziris being taken. The same is true of Zimara, but the geography of this part is very obscure.

VI. Measurements from Issus.

	Map-distance.	Road-distance.
Issus to Mopsuestia	29	33
„ Adana	51	49
„ Tarsus	77	75
„ Mopsucrene	103	97
„ Podyandus	133	121
„ Cybistra	174	169
„ Baratta	206	206
„ Iconium	249	251
„ Tyana	205	204

The earlier road-measurements agree with the itineraries as restored by Prof. Ramsay in the *Journal* for 1903, Part ii. p. 408. The distance between Podyandus onwards is given in H. G., p. 357, as 54 m.p. to Cybistra, 41 to Barata, and 50 to Iconium. Tyana is measured *viâ* Cybistra, from which it is distant 39 m.p. I think it most probable that Archelais, Sebastia, and Cæsarea Mazaca were fixed from Issus; but though the figures, such as I can get, agree approximately, I cannot get exact measurements of the road-distances. For the measurements from Laranda to Seleucia and Celendris, cf. H. G., p. 362. Mopsucrene may have been fixed from Issus; Podyandus was not. The resumption of conformity after they were passed is interesting, and we should not expect conformity in their case—they are intermediate places. The map-distance of Podyandus from Cybistra is 46 miles.

REVIEWS.

EUROPE.

British Trade.

'Wirtschaftsgeographische Studien aus Grossbritannien.' Von Stefan D. Popescu, Professor an der Handelshochschule zu Jassy. Leipzig: 1903.

In the summer of 1902 (May—August) the author made a journey to Great Britain, where he studied the navigation, shipping, and trade of this country with a view to the present study. In compiling the same, he has made especial use of the publications of the Board of Trade, such as the Annual Statements (1) of the navigation and shipping, and (2) of the external trade, of the United Kingdom. Four main divisions are adopted, in which the Bristol Channel, the Mersey, the Clyde, and the British coal-trade are successively chosen as the subjects of discussion; in relation to each, a mass of useful and instructive, if not very novel, statistics and observations are collected. The physiographical circumstance of the Bristol Channel, Mersey, and Clyde basins is the subject of particular attention; questions of local orography and hydrography, of meteorology, of tides and alluvial deposits, are discussed with some detail; and the historical development

of the local commerce is fairly well treated, though M. Popescu is content to quote reviews, guides, and handbooks for this part of his inquiry. English names and citations are generally accurate, but occasionally require revision, as is shown by "Cootswold," "Penin," "entrepriese" (pp. 23, 47, 82). The tabulated comparison of the coal output and trade of the chief coal-producing countries is one of the best features of the volume.

C. R. B.

ASIA.

Geography of India.

'India.' By Colonel Sir T. H. Holdich, K.C.M.G., K.C.I.E., C.B., R.E. Regions of the World Series. London: H. Frowde. [1904.] *Maps. Price 7s. 6d. net.*

In the now almost-forgotten pages of the 'Noctes Ambrosianæ' it is recorded how, when the eloquence of the rest of the company was found unequal to the occasion, a unanimous cry of "Describe, Shepherd, describe," never failed to elicit a satisfactory response. Had Sir T. Holdich been numbered amongst the elect of Maga, there is little doubt but that his fellows would have accepted his powers of description as an equivalent alternative to those of their Ettrick comrade. In the present work he sets himself down to treat descriptively the "infinite geographical variety" of the region we know as India, and well has he performed his task. He has enjoyed opportunities such as fall to the lot of few, even in the roving service to which his professional life has been chiefly devoted; and to the knowledge and experience of the trained observer he has added an artistic sense of proportion in both the selection of his points of view and the language in which he conducts his reader from the "sun-dried desolation" of the coast of the Arabian sea to the "terraced rice-fields" of Kun-Long, which looks across the river at China, or, again, from the mighty crags of the upper Indus to the golden sands and waving palm-groves of Ceylon.

In the technical treatment of his subject, a commendable feature is the compendious form in which the author has summarized the most recent conclusions regarding the main physiographic characteristics of India and its neighbourhood. Some of these conclusions are still, no doubt, conjectural, and likely to remain so, as, for instance, the southern limit of the now submerged Lemurian region, as it existed at the end of the Jurassic period; whilst others, such as the north-western limit of the Himalayan system, are matters of controversy. In regard to the latter, the author, whilst adopting the conventional view of geologists, that the system does not extend beyond the Indus, quotes, with apparently some degree of agreement, the other theory supported by the analogy of the passage of the Satlaj and Gandak, of the continuation of the system south of the Gilgit valley. On these great natural features of the north, and their more modern supporters on the south-west, the author dwells long and lovingly, as is only to be expected of one who for so many years toiled and travelled among them. He may, indeed, dwell upon them too long and with superabundant rapture to please those of his readers who belong to what Kipling, another sojourner in the north, contemptuously stigmatizes as the "Shigramitish" people, who traverse the tame plains of the peninsula in "shigrams," or vehicles drawn by bullocks, and are more than contented with an altitude of 3000 feet for their summer resorts. His justification lies, however, in the dominating influence these natural barriers have exercised upon the history of the country, and the leading part they play, and must continue to play, in its political destinies. In connection with this aspect of the tracts in question, the author wisely does not hesitate to overstep the political frontier of India, since the real frontier includes, as he indicates, both Afghanistan and Baluchistan, and, in

view of recent events, the west and south of Tibet may be added. It would have been a pity had the admirable chapters on the two first-named countries been omitted and the reader thus deprived of the lucid explanations given therein of the true bearings upon the security of India of the approaches to that country which lie within and along the territories of the Amir. The problem of the British army, said Mr. Balfour at Glasgow not long ago, is the problem of the defence of Afghanistan. That country alone offers the necessary "take off," so to speak, for a spring upon the open plains of the Panjab. In this work will be found a masterly exposition of the strength and weakness of these main lines of approach under modern conditions of transport, with a brief review of the use made of them in the invasions of the past. At the same time, it is inadvisable, in the existing circumstances, to concentrate attention on the north-west alone, and to exaggerate, as the writer seems somewhat inclined to do, the inaccessibility of India along its northern frontier.' Difficulties hitherto deemed insuperable are giving way before the resources of modern engineering, and communication is established between countries which Nature apparently intended to keep for ever separate. Nipal, Bhutan, and Sikkim are "buffer states" only in name and in the sense in which that term was used, for example, in the first and abortive settlement of the Siamese question. They cannot be counted in the same line with Afghanistan. Beyond them lies a tract which, however inhospitable, affords ample room for political agitation and intrigue, a fact of which the smaller units just mentioned have showed themselves fully cognisant. Nipal remembers, probably, the passage of the Himalaya in 1792 by an invading army from China, which dictated terms to Khatmándu from the south side of Gaurishankar, whilst the ethnographic composition of the population of Assam and eastern Bengal, and the irruption of Shan tribes within historic times, indicate that in these directions, also, India is by no means invulnerable, though less open to attack than upon its western flank, which lies in the line of motion of the more warlike and ambitious elements of continental Asia.

In connection with the latter region, the author gives a very valuable account of the once much-frequented routes between India and Southern Persia, some of which have recently been resuscitated for traffic. For a long time past this tract has been almost ignored, and Sir T. Holdich is doing good service in welding into the geography of India a region with which our acquaintance has been lately much increased by surveys, by a revival of interest in the return journey of Alexander and his fleet, and still more, perhaps, by the growing attention which is being paid to the valuable record of Arab geographers. That race, as the author reminds us, always kept a keen eye on the Makrán routes, and as soon as they obtained command of the narrow sea, possessed themselves of them, and, under the protection of their vessels, perpetrated the only successful invasion of India from the west which took a route other than those of the Afghan passes. For the present, the interest in this remarkable tract has left the coast for the interior, and though it may not be reasonable to hope that a revival of Indo-Persian trade will restore its former prosperity to the country, substantial improvement may result from the protection of the roads, and the gradual establishment along them of local centres, introducing fresh blood, and attracting to settled occupations the sparse population of the surrounding "dasht." Reverting, for a moment, to what was said above as to the anxiety of the Arabs to secure maritime supremacy on the west coast of India, the far-sighted saying of Bacon may be remembered, that "the wealth of both Indies seems in great part but an accessary to the command of the seas." From the earliest days of Mediterranean civilization there was competition for the trade of India, and it is interesting to compare the conditions of former

intercourse with those of the present day, and to note the curious reversal of the course of merchandise which has resulted from the development of ocean traffic. When goods were conveyed by baggage-animals or small coasting craft, the exports from India consisted mainly of luxuries, such as gold, precious stones, spices, and rare fabrics of "woven dew," all representing high prices in small bulk. All, moreover, were the products of artisans working for the upper classes and probably bound to the *entourage* of a chieftain's court. Long sea traffic in vessels of large capacity has diverted the export trade from the city to the village. The cheap surplus produce of the peasant has taken the place of the costly superfluities of the rich, and manufactures have given way to raw material. On the other hand, luxuries, except gold and silver ornaments, pass from west to east, and from the clocks and carriages of the raja to the beads and turban of the ryot, all comes from Europe. India indents upon England for her finer fabrics, instead of providing them for us, and whilst we have naturalized here the term *calico*, derived, it is said, from an Indian port, the Indians have assimilated *manjar*-pat, a cotton fabric under more than suspicion of a *Manchester* origin. From an artistic standpoint this change of direction, the author emphatically pronounces, has little to commend it, for not only are exotic products introduced with the baleful air of (say) Birmingham floating round them, but many of the indigenous arts fall before "the patron and the gaol," in other words, before the globe-trotter, to use Tom Coryat's now classic phrase, and the prison-factory. The association, however, of art with religion, which, as Sir George Birdwood has shown, is in India indissoluble, has proved the safeguard of the domestic industries of the country, and in these, with better material and improved handiwork, the traditional purity of form and design remain intact.

In other respects, the British connection with India, reviewed by the author in his political chapter, is such as to bear out what the late Lord Derby—in 1858—declared it to be, a great glory, a great responsibility, and a great danger. Sir T. Holdich seems to be of opinion that in certain directions this connection might advantageously be drawn closer, as, for instance, through the colonization by British settlers of the vale of Kashmir. There are, however, two sides to that question, and it is doubtful if such a community would turn out to be a source, as he suggests, of strength to British rule. The climatic conditions are, probably, almost perfect, but they cover only a portion of the field. More important is the surrounding social and moral atmosphere, which must always remain that of a subject Oriental race. The colony would either be one of employers, or it would lose its racial prestige by competing with natives in every-day means of livelihood. The strength of the British administration lies in sympathetic aloofness, not in fusion of either race or individual interests. "Those who want to rule people," says Selden, "make themselves as different from them as possible. The stranger, by his very isolation, acquires a superiority." Social intimacy with the natives, as Sir T. Holdich points out in another passage, is neither desired by them nor desirable for the foreigner. In India, the caste system, on which the whole scheme of life is based, is so strongly assimilative that no ruling race which has once made its home in the country has been able to resist absorption, and thus losing its distinctive character and its independent existence. A change of creed or mode of life is not essential to this influence, but the environment tells upon the new-comer, and his most vital interests detach themselves from those of his race, with the centres of which he gradually loses touch. This is a factor in the Brahmanic system on which the author in his account of that form of religion seems to lay too little stress, as he speaks of "conversion" to Hinduism, when the process is really incorporation, or submersion. There are other points in his account of the people of India, especially as to "origins," which might be selected as showing both

that the subject itself was one requiring vast research, and that the author has not been able to make himself as familiar with the latest outcome of that investigation as he has been with the physiography of the country. One can say, indeed, of ethnography as the Irish lady said of scratching—once you begin, it's hard to stop!

J. A. B.

The Exploration of Further India.

'The Story of Exploration.' Edited by J. Scott Keltie. 'Further India.' By Hugh Clifford, C.M.G. London: Lawrence & Bullen. 1904. *Maps and Illustrations. Price 7s. 6d.*

Mr. Clifford is much to be envied the task which fell to him when called upon to write the story of exploration in Further India. To the general glamour of the East, with its barbaric pomp and more or less mysterious origins, is added in this case, as a further source of interest, the exuberance of the natural forces which oppose the hardy explorer in the jungles and river gorges of the great Eastern peninsula, while the unhackneyed nature of the subject—for to the general public even the main actors, such as Mendez Pinto or Francis Garnier, are somewhat shadowy personages—is another decided advantage. Mr. Clifford's literary experience has enabled him to weave a story of romantic interest from these favourable materials. While the great bulk of the book is devoted to the modern exploration, and of this again a preponderating part, no doubt of set purpose, to the Lagrée-Garnier expedition, the opening chapters give a brief but effective view of the main historical epochs, each marking a definite stage in the gradual unfolding of these Eastern regions to the Western world. The author's standpoint is throughout, in fact, more pronouncedly historical than geographical, and there is little definite attempt to sketch the broad geographical problems which awaited solution at successive epochs, and which, somewhat strangely, are most fully touched upon in the concluding chapter. This is, perhaps, due to the geographical restrictions by which the author seems to have felt himself bound, most of the questions involved, *e.g.* that of the source of the Irawadi, being equally the concern of neighbouring regions.

Among the many interesting questions connected with the early intercourse between this region and the West, or nearer East, Mr. Clifford deals with the possible location of the Biblical Ophir in the Malay peninsula (a theory towards which he seems favourably inclined); the explanation of the statements of Marinus and Ptolemy, and the identification of the latter's Catigara in Southern China; the opening of the regular sea-route round the Malay peninsula, with its development in course of time into a well-frequented track; followed by the voyages along it of Marco Polo and other mediæval travellers. Then comes the irruption of the Portuguese "filibusters," as they no doubt are rightly termed, and the establishment of Portuguese supremacy under the stern and pitiless energy of men like Alboquerque; the successful rivalry of the Dutch and English, and the development of their commercial undertakings; and, finally, the detailed story of modern exploration, centred, as before noted, in the personality of Francis Garnier and the exploration of the Mekong, but comprising abundant details on British activity further west, as represented in the work of Hannay, McLeod, Richardson, McCarthy, and others. A special chapter deals with the problem presented by the evidence of a former Khmer civilization in the ruins at Angkor Wat.

On a few points of detail Mr. Clifford falls into inaccuracies, showing him to be not quite at home in some of the outlying parts of his subject, while the researches of some former writers (Schlegel, Anderson, Gerini, etc.) seem to have escaped

him. Thus we miss any reference to recent discussions on localities mentioned by old travellers, such as the Doudin and Nicoveran of Oderic. A somewhat fuller treatment might have been accorded, perhaps, the early modern period, particularly the establishment of English trade with Siam; no mention being made of the voyage of the *Globe* under Hippon. But considerations of space no doubt stood in the way here. And any slight defects are fully compensated by the author's personal knowledge of the countries and peoples of which he writes, which enables him to impart a high degree of actuality to his narratives, the human interest of which is one of their prominent features. The book is excellently illustrated by maps and photographs.

Affairs of Asia.

'On the Outskirts of Empire in Asia.' By the Earl of Ronaldshay. Blackwood & Sons. 1904. Pp. xxii., 408. *With two Maps.* *Price* 21*s. net.*

This is a skilful compilation by a well-known Asiatic traveller. The map at the opening of the volume shows Lord Ronaldshay's journeys, which are here set forth, to extend from Constantinople to Tokio. The line leads by Konia, Aleppo, and Mosul to Bagdad, thence to Teheran, to Resht and Baku, across the Caspian, to Merv and Bokhara. From his route, thence north-eastward, the author turns aside twice, into the Tian Shan, and into the district of the Lesser Altai. Thereafter he joins the railway, travels by it to Port Arthur, and visits Pekin and Wei-hai-wei, besides Japan. Truly a comprehensive course, well fitting the author for his ultimate task in the present volume, which is to set forth in sectional analysis the large political problems of the East, both Near, Middle, and Far. But the book is by no means a political treatise only. Lord Ronaldshay affords his readers a geographical groundwork by describing his travels at length, and makes full use of his power of clear narrative; in fact, the descriptive part of the book is considerably the larger. A short section of the book (three chapters) is devoted to sport, in successful search of which the author paid his visits to the Tian Shan and the Siberian Altai. A book of this sort, of course, contains no scientific or specialized matter, but as regards general information, Lord Ronaldshay writes almost encyclopædically. Consequently, the student of Asiatic affairs need not go beyond this book for a groundwork in his subject, and will have the advantage of finding his information in an excellent geographical setting. There are good photographs, and, besides the general map, one of Asiatic Turkey having particular concern with the Bagdad railway, to which the author devotes an interesting chapter.

AFRICA.

African Races.

'Recherches anthropologiques dans l'Afrique orientale: Égypte.' Par Ernest Chantre. 4°. xviii., 318. *Illustrated.* Lyons: Rey. 1904.

The author, who has been occupied for a long time with Egyptian skull-forms, here puts forth, in a magnificent volume, a general survey of the results attained by himself in the special studies which he made on the spot between 1898 and 1904, combined with the records and observations of other anthropologists. He begins from the earliest times, the Stone Age, of which many relics were found by various explorers between 1868 and 1894; but he hardly gives credit where credit is due. For unquestionably it was Prof. Petrie's discovery of his "New Race" cemetery near Nagada, in 1895, which first brought these isolated observations into mutual relation and prominence. That explorer certainly was the first to give the

craniologists any material for a study of this period. M. Chantre passes on to the Metal Age, and so into historic times, dealing with the physical characteristics of the ancient and mediæval Egyptians from mummies, paintings, and statues. The second half of the volume is concerned with the modern inhabitants: first, the Fellahin; second, the bedawins; thirdly, the Nubians; lastly, the inhabitants of the eastern Sudan. The author was allowed by the local authorities to study the soldiery of various races, and he was diligent in collecting types among the civilian population. The photographs are excellent, and admirably reproduced. The chief fault which a cursory inspection of the volume reveals is one to which many Frenchmen of science are prone, namely, excessive length caused by elaborate exposition of many things which have been fully dealt with by earlier writers. For instance, what is less necessary in a book of this kind than discussions on ancient Egyptian beliefs in regard to the dead, or on the whole art of mummification? In lecturing it is well to assume next to no knowledge in the audience, which has no opportunity for reference to other authorities; but it is needless in writing books. We have nothing else, however, to complain of in a volume distinguished as much by thoroughness and accuracy as by its truly admirable typography and illustration.

The Masai.

'Die Masai; Ethnographische Monographie eines ostafrikanischen Semitenvolkes.' By M. Merker. 6 *Plates*, 150 *Illustrations in the Text, and Sketch map*; xvi. + 420 pp. Berlin. 1904. *Price* 8 *marks*.

During a residence of some seven years in German East Africa, Captain Merker found time amid his official duties to collect a great mass of anthropological data amongst the Wandorobo, the Wakwafi, and especially the Masai inhabitants of that region. His observations, all made at first hand, are embodied in this handsomely furnished volume, which thus forms a welcome supplement to the late Joseph Thomson's 'Through Masailand,' which, although not mentioned and apparently unknown to the German writer, covers much of the same ground, and still remains our chief authority on the remarkable social and political institutions and military organization of the Masai nomads. About half of the present work is occupied with these and other ethnographic matters, which are disposed in three sections, and treated in almost exhaustive detail, with a clearness and thoroughness that leave nothing to be desired, while the numerous illustrations of types, implements, costumes, dwellings, and the like, partly from drawings and partly from photographs, maintain the high repute deservedly enjoyed by German typographic art for such reproductions.

But, owing to its startling novelty, most readers will perhaps be attracted in the first instance to the fourth section, in which the author elaborates his strange and strained views on the Semitic origin of the three above-mentioned ethnical groups. These represent three successive waves of migration from North Arabia, where before the dispersion they had long dwelt together with the kindred Israelitish people, from whom they separated at some remote epoch, but apparently between 5000 and 4000 B.C., and made their way by the isthmus of Suez and down the west side of the Red sea to their present domain in the Masai steppe lands east of Lake Victoria Nyanza.

It should be at once stated that this singular assumption is entirely based on the national traditions, myths, legends, and religious observances of the Masai people, which Captain Merker has collected with rare diligence, and which are here for the first time given to the public. That they present astonishing and most unexpected coincidences and parallelisms with the corresponding features of early

Jewish social and religious life cannot be gainsaid, so much so that one may venture to say that henceforth Masai folklore can no longer be neglected by the "higher critics." But that they lend support to the author's prehistoric migration theories will be believed by nobody so long as the resemblances admit of a less extravagant explanation. Nor are these theories at all strengthened, but rather upset, by the wild etymologies somewhat inconsiderately brought to their aid. Thus the mythical *El dinet* people are the Hittites, and they dwelt long beside the *El eberet*, *i.e.* the Hebrews, sprung from the Biblical *Eber*, while the El dinet god *Nyau* is the Masai god *Ngai*, and the Hebrew *Yahveh*, the Assyrian form of which is *Yau*, this being the old Masai word *hau* = "great." All this is confirmed by the first of the ten Masai commandments: "There is one only God. Heretofore you called Him . . . *E'magelani* ('Almighty'); henceforth you shall call Him Ngai," as in Exod. vi., where the "Almighty" (*Shaddai*) is similarly replaced by Jahveh. But this was in the Exodus period, say 1500 B.C., or about 3000 years after the Masai migrations (see above), so that the reference, instead of confirming, destroys the whole scheme. The same remark applies to the other "identities," as they are called, such as *Abel* = the Masai *Nabe*; *Abraham* = *Narabá*, both being rich in cattle, and marrying in their old age; *Moses* = *Musana*; *Tubal-Cain* = *el konono*, where Tubal is the Somali *tumal*, and the Galla *tumtu*, both meaning "smith," while *Cain* is the *Cainan* of Gen. v. 9, which, like the Masai *el kono*, also means "smith," so that *Tubal-Cain* = "smith-smith." In all these equations the chronological difficulty is acutely felt, but is met by the suggestion that the myths and associated names are pre-Biblical, "eine gemeinsame Uranschauung," that is to say, the common property of the proto-Babylonians, proto-Israelites, and proto-Masai, which, after the dispersion, was carried away by them, and further developed independently in their later settlements—Mesopotamia, Palestine, Masailand. But the languages of these peoples are radically distinct, and if they were able to carry away and preserve such a body of their common folklore, it will be asked why they failed to preserve something of their common speech. Captain Merker's assumption presents many other most formidable difficulties, which are not found in the more obvious view that the Masai derived their scriptural legends and practices from contact with the Judaizing Falashes of the neigbouring Abyssinian uplands.

Besides a sketch-map, showing the full extent of the Masai domain, there are six plates, giving the designs depicted on the different tribal shields, the "coats-of-arms" of the various septs, and the brands of ownership on the bodies and ears of the cattle and on the warriors' spear-heads.

A. H. KEANE.

AZURARA'S CHRONICLE.

'Les Manuscrits de la "Chronica do descobrimento e conquista da Guine" par Gomes Eannes de Azurara, et les sources de João de Barros.' By Jules Mees. Lisbon (Bibliotheca da Revista Portugueza Colonial e Maritima).

In this valuable pamphlet, disfigured by many bad misprints, Dr. Mees describes (1) a manuscript in the Munich Library [Cod. Hist. (Lusit.) 102] which once belonged to the orientalist Quatremere, and was purchased, with the rest of that savant's library, by Maximilian II., King of Bavaria, in 1859; (2) a manuscript in the Madrid National Library, numbered 2424; (3) a manuscript in the Munich Library, in the Collection of "Valentin Fernandez Alemão," and in a volume once belonging to Conrad Peutinger, and entitled by him 'De insulis et peregrinatione Lusitanorum.' The first and second of these are simply copies of the Paris Manuscript of Azurara, which has been printed by Santarem

and translated in the Hakluyt Society's version of the 'Chronicle of Guinea.' The third is derived from the same source, but in a less simple manner. It is not a full copy, but a much shortened form. The 97 chapters of the Paris text are here reduced to 61; chapters 5–7, 28, 49–50, 66, and 97 are wholly omitted; whole groups of other chapters are rolled into one—thus 37–48, 51–9, 68–9, 72–4, together amount to four only in Valentin Fernandez' recension. The copyist was apparently in a desperate hurry to finish his work, and makes short work of many of the reflections with which Azurara loads his chronicle, though adding a couple of allusions to the voyages of Cadamosto (see folios 215, recto, 260, verso, of the Fernandez manuscript). As to the great Paris manuscript, Dr. Mees seems inclined to believe the tradition of Fr. Luiz de Souza, according to which the Infant D. Henry presented this copy to the King of Naples in 1457. He also suggests that the 'Chronicle of Guinea' in this form was used by Las Casas in his 'Historia de las Indias.' From a note on fol. 161, recto, it is clear that the manuscript in question remained in Spain as late as 1702; Luiz de Souza appears to have seen it at Valencia many years earlier (see 'Historia de S. Domingos,' p. 332, edition of 1623).

Dr. Mees concludes with an interesting comparison of certain passages of Azurara's *Guinea* with corresponding parts of Barros and Pacheco Pereira's *Esmeraldo*. The parallel between the last-named and the narrative of Gomes Eannes in the matter of the first rounding of Cape Bojador is very striking, especially as Pereira nowhere acknowledges any obligation to Prince Henry's panegyrist (*cf.* 'Esmeraldo de situ Orbis,' p. 39, edition of 1892; 'Chronica de Guiné,' p. 57, edition of 1841). Barros, on the contrary, frankly acknowledges that Azurara's *Guinea* is the chief source of his narrative for the events of Prince Henry's life, though for Madeira he also employs certain records in the possession of the heirs of João Gonsalvez Zarco, the principal leader in the Portuguese discovery of that island. It is not, therefore, surprising to find that he makes some use of nearly every part of Azurara's African chronicle, only passing entirely over the matter of some 23 chapters out of 97 (viz. chs. 1–3, 6–7, 24–5, 28, 49–50, 61–2, 70, 78, 84–5, 89–92, 95–7). C. R. B.

History of Madagascar.

'Collection des Ouvrages anciens concernant Madagascar.' Vols. i. and ii. Paris: Comité de Madagascar. 1903–4. Pp. 527, 559.

This valuable series of *Fontes* for the history of the great African island, under the general direction of the veteran Alfred Grandidier and three colleagues, opens with a volume containing all those passages relating to Madagascar which are to be found in French, English, Dutch, German, Portuguese, Spanish, Italian, and Latin works between 1500 and 1613. The second volume continues the 'ouvrages ou extraits d'ouvrages relatifs à Madagascar,' from 1613 to 1640. Thus far, we have over a thousand pages of material for the history of the "Island of the Moon," and the whole undertaking is to comprise four times as much—ten volumes in all, with an average of from 450 to 550 pages, furnishing a complete collection of description and reference, in all languages, and by men of every nation, down to 1800. The material printed appears to include every passage of importance necessary to illustrate European dealings with Madagascar, together with the history and manners of the native races from the end of the fifteenth to the end of the eighteenth century. Sufficient explanation and emendation is furnished for the thorough understanding of the texts. Unpublished manuscript sources have been consulted, early maps have been abundantly reproduced; and everything has been done to "erect," in the editors' words, "a monument not less valuable than the

sculpture of Barrias," unveiled at Tananarivo in 1901. Alfred and Guillaume Grandidier have given in these volumes a fresh and striking proof of French interest in the great insular possession which has been a subject of intermittent national ambition at least since the days of Richelieu, and whose acquisition in our own time is a proof of the persistency and success with which France has worked towards some at least of her "traditional aspirations."

In one point I should like to express a certain dissent from M. Alfred Grandidier. He denies that Marco Polo has any knowledge of Madagascar or any intention of referring to that country; he therefore excludes Polo from his collection of sources, and makes the Portuguese Covilham the first to name Madagascar to Europeans—"Contrairement à l'opinion generale, le pays que Marco Polo a nommé tantôt Madagascar tantôt Mogelasio . . . n'est certainement pas l'île à laquelle nous donnons aujourd'hui ce nom . . . Polo n'ayant pas eu connaissance de l'île que nous nommons Madagascar . . . Première mention de Madagascar en Europe par Pierre de Covilham, en 1489" (pp. ix., x., 1). I do not question that in Messer Marco's sketch of *Madeigascar* there is an evident mixture of genuine and spurious particulars, the latter perhaps referring to the region of Makdashau, Mogdicho, or Magadoxo, and other Arab colonies of the Somali coast; but I think there is a good deal more to be said. First, the *name* is undoubtedly in Polo. Thus in the oldest text, that of the Paris manuscript (1116 Fr., in the Bibliothèque National, printed by the Paris Geographical Society in 1824), I cannot find any *Mogelasio*, nothing but *Madeigascar* (see *Recueil de Voyages*, etc., tome i., 1824, pp. 232–4). In M. Pauthier's text, the next in importance, it is always *Madeisgascar* (Pauthier, 1865, pp. 676–9). In the primitive Latin, printed by the Paris Geographical Society in the same volume with the fundamental French text, it is *Madagastar* or *Madagascar* (*Recueil*, etc., as above, p. 469); in Ramusio, it is *Magastar* (R., II., 57 F.—58 B., edition of 1583). Where is the authority for *Mogelasio* in the 'Livre des Diversités' of the Old Venetian? And why should the form of *Madagascar*, in any case, be considered a corruption of *Mogdicho*? Why should it not rather be a word meaning "Land of the Malagash," as M. G. Ferrand has suggested ('Les Musulmans à Madagascar.' Paris, 1893)?

And secondly, as to the thing; *Madeigascar* is truly described by Marco Polo as one of the greatest and noblest of islands, is placed by him with fair accuracy "about a thousand miles" south of *Scotra*, or Socotra, and is estimated without extravagant error as about 4000 miles in circuit. His Madagascar fauna is mostly absurd, and his statement that the people as a whole "adored Maomet" sounds at first little better; yet undeniable evidence has been found of Arab colonization at various points of the coast, especially in the extreme north-west and at several places on the eastern seaboard. Even the boars' teeth of Polo's narrative, which, according to the Italian traveller, were carried to Kublai Khan as curiosities, and which weighed more than 14 lbs. a piece, though possibly to be identified with hippopotamus ivory from the mainland, derive some support from the ancient name of *Nossi-Dambo*, or "wild-boar island," now long fallen into disuse.

Lastly, as to Marco's language about the currents which here set southward with such force that no one, if he passed beyond Madagascar, could return against them (*Recueil*, p. 233), can we say that this suits the Somali coast and Magadoxo so well as the Mozambique channel and Cape Corrientes? From the latter "runs southward along the coast the permanent Lagullas current, and Polo's statement requires but little correction" (Yule-Cordier, 'Marco Polo,' ii., 415).

C. R. B.

AUSTRALASIA AND PACIFIC ISLANDS.

Fiji Folk-lore.

'Tales from Old Fiji.' By Lorimer Fison. London: A. Moring, Ltd., The De La More Press. Pp. i.–xlv., 1–175. 22 *Illustrations and a Map.*

Folk-tales obtained from reliable sources and told in a pleasing manner, as are these, have both a literary and a scientific value, and from both points of view the old Fijian tales told by Mr. Fison deserve to be widely read. A large number of interesting ethnological data will be found embedded in the tales as well as in the introduction and appendix. In the introduction will be found notes of various words that in one sense have a harmless significance, but which are employed to convey a sinister or evil meaning. Among the Windward islands of Fiji two sorts of turtle were spoken of, "short turtle" and "long turtle." Of these the former referred to the real turtle, but the latter to the dead body of a man which was to be eaten. Among the Leeward islands a like distinction prevailed, pig being substituted for turtle. There is also a long discussion on the origin of cannibalism. Mr. Fison holds that in former days the Fijians were scantily supplied with animal food, and as they were subject to that insatiable craving for animal food which an exclusively vegetable diet produces, they betook themselves to human meat. It was hunger, and not superstition or revenge, which led to cannibalism. Most of the dozen tales are interesting as stories quite apart from the psychological or ethnological data they contain; some are myths of origin, others account for the migrations of peoples, or narrate the deeds of doughty chiefs; one tells of the untimely death of a lad who was the offspring of the sun and a beautiful human girl. One boastful tale states that "Napoleoni was a son of Tonga, for his mother came to us in a ship from the land of Merikei. She was a young woman, tall and fine; and after a while she sailed again to her own land, where she brought forth a child, though no man had her to wife, and this child she called Napoleoni. Now, after many days, when he was grown, the men of Faranise sent ambassadors to Merikei, begging for help against Uelingtoni. . . . So he led the men of Faranise. I could tell you of his mighty deeds—how he smote the enemies of Faranise, though they were many and strong; how he chased Uelingtoni from land to land till he caught him at Uatalu, and banished him to a desert island, where he died."

THE MONTHLY RECORD.

EUROPE.

Is there a Glacier on Ben Nevis?—In the March number of *Symons's Meteorological Magazine* this question is answered in the affirmative by the Rev. R. P. Dansey, who points out that there is one especial feature which favours the accumulation and duration of snow on Ben Nevis not to be found in nearly such a marked degree on any other Scottish mountain. The summit plateau, which rises steeply from the south-west—the Glen Nevis side—terminates, after forming the summit crest, in a magnificent series of precipices, nearly 2 miles in length, overlooking the north-east face. At the bottom of these precipices runs the small stream of the Allt-a-Mhuilinn, whence the corrie takes its name (see the photograph here reproduced). On the other side of this rise again the steep scree-covered slopes of Carn Mor Dearg, 4012 feet, which at the head of this great corrie joins Ben Nevis on the east by an arête which never falls below 3478 feet. The

corrie is enclosed on all sides except the north by very high ground. These grand cliffs, however, their 2 miles of length seamed by buttress, ridge, and gulley, not only keep off the sun, but they also intercept the warm Atlantic winds which blow over the top and on to the slopes of the opposite mountain, Carn Mor Dearg, leaving the snow-covered corrie in a cold atmosphere of its own making. By far the greater part of the snow that falls on Ben Nevis with all winds from south by west to west-north-west—which are the prevailing winds, and bring the heaviest snowfalls—is swept off over the precipices, where it accumulates in the great hollows and gullies underneath, in the Allt-a-Mhuilinn corrie. The maximum depth on the summit is generally reached about the end of April or some time in

CORRIE OF ALLT-A-MHUILINN, BEN NEVIS, SHOWING SITE OF GLACIER AT END OF APRIL.

May. The snow usually disappears from the summit about the beginning of July, except drifts, but the much greater accumulation below still remains. The minimum depth of snow under the precipices is usually found at the beginning of September. The Rev. A. E. Robertson says of these accumulations of compacted snow, "If you were to examine into it, I am sure you would find them practically ice, say after 12 or 24 inches below the surface, and I think also they would show glacial movement as well, so if that makes a glacier, then I think you have it on Ben Nevis." They have never been quite melted away within living memory, so no one knows what is below, or how much is below. Mr. Robertson crossed the largest "glacier" between the Observatory Ridge and the N.E. Buttress (climbers' names for routes up the precipices) in August last, and said the length of the "glacier" from top to bottom was then 300 feet; that it was of an average breadth of 50 yards, hard as a board, ribbed just like *névé* in the Alps, and that it would not melt much more, if at all, that year. In many places at its side he could look over into the bergschrund between the rocks and the snow, and could see down a great way, in many places 50 feet; so Mr. Robertson concluded that if it was 50 feet at the sides, it must have been much more in the middle. The rocks near it were heavily glaciated and rounded off. Mr. Robertson, who has a knowledge of all the mountains over 3000 feet high in Scotland, says that it is on Ben Nevis only that even a semi-glacier exists, and

that the snow-beds in the Cairngorms are much more open, and therefore more liable to be practically melted away in a hot summer. The level of the Ben Nevis "glacier" would be about 3000 feet, part of it higher, and part, perhaps, lower. The corrie of the Allt-a-Mhuilinn is probably the wettest spot in Great Britain; if a rain-gauge were placed, as Mr. Gethin Jones recently suggested in *Symons's Meteorological Magazine*, half a mile on the lee side of the summit of Ben Nevis, that is the side opposite to that on to which the prevailing rain-bearing winds blow, this corrie would be the spot. But the difficulties attending its reading would be very great, especially from October to June, when the corrie is often full of drift snow; and on the advent of warmer weather, avalanches, due chiefly to the giving way of the cornices on the cliffs above, crash right down into the centre of the corrie.

The Simplon Tunnel.—The last remaining barrier dividing the galleries driven from the north and south ends of this tunnel was pierced in February last. In spite of the difficulties and delays by which the undertaking has been beset, the allignment had been accurately maintained, and the junction was effected in accordance with the calculations of the engineers. Among the chief difficulties encountered was the amount of underground water to be dealt with, and the great heat experienced. We hope to recur to the subject of the tunnel, as it affects the main lines of international communication in Central and Western Europe.

A New Stalactite Cave near Triest.—Herr G. A. Verko, leader of the Grotto Section of the Triest Touring Club, has discovered at Markovsina, near Triest, a cave of great extent. With its many spacious halls full of the most beautiful stalactites, it far surpasses in grandeur all other grottoes of the Karst known down to the present time. The most interesting item in the discovery is a great subterranean watercourse running the whole length of the principal cavern. Two perpendicular chasms, one 115, the other 72 feet deep, lead into the interior of the cavern. Some blind troglodyte animals, including several quite new species, were found. Below a third passage into the cavern, at present completely blocked in consequence of an infall, there lies a rich deposit of fossil remains of animals dating from the Ice age. Even at the first exploration of the cave many parallel caverns were found, and numerous side passages containing fine groups of large sinter formations of all colours.

The Distribution of Population in Sweden in Relation to Geological Formations.—Hr. Per Stolpe has compared the density of population with the geological deposits, and finds that there is a marked connection between them (*Ymer*, Häft 3, 1904). Other factors have, no doubt, contributed to the present distribution. One of these is the climate, but its effect is not nearly so great as might be expected. In some points, also, concentration of population may be caused by the lumber and iron industries. But on the whole the influence of geological conditions is apparent—the limit of marine deposits, the occurrence of calcareous soil, and the configuration of the surface. As Prof. Högbom has noticed in Northern Sweden (vol. 21, p. 75), calcareous soils derived from the Silurian formation are especially fruitful. It has also been remarked that the vegetation is more luxuriant over the latest eruptive rocks, basalt and rhyolite, than in the surrounding districts.

Notes on Iceland.—The expedition referred to in vol. 22, p. 326, has returned to Denmark, having surveyed about 450 square miles of the most difficult country in the island. The Hvannadalsnukr, in the Vatna-jökul, the highest point in Iceland, was found to have a height of 6955 feet, whereas the former triangulation gave only 6427 feet. In another paper in the *Geografisk Tidskrift*, Bol. 17, Hefte viii., Prof. Prytz speaks of arboreal vegetation in Iceland. There is evidence that the island was originally covered with wood from the shore to the

mountains, and probably the forests were composed of birch, willow, and mountain ash, which are still found in small copses, especially the first. The inhabitants have cleared the wood to provide pasture land, and have used it to make charcoal and to roof their houses. The further the trees are from the villages the larger their growth. Captain Carl Ryder, in 1898, was the first to propose the re-afforestation of the island, and now an arboricultural society in Reykjavik is laying out plantations, and the agricultural society of Iceland is promoting the establishment of arboricultural societies throughout the country. Dr. Thoroddsen discusses in *Ymer*, Häft 4, 1904, the question of a post-glacial land connection between Iceland and the Færöes, which has been assumed by botanists to account for the vegetation of the island. At the beginning of the Miocene period land certainly extended over the Atlantic from Scotland across the Færöes and Iceland to the east coast of Greenland, but subsequently sank, and the island, much larger at the beginning of the Pliocene, gradually sank, and its present hydrographic system was formed. The dolerite streams ejected at the end of the period simply adapted themselves to the valley system already developed. The hypothesis of a post-glacial land connection involves an elevation of about 380 fathoms, which would have turned the North sea and Baltic into dry land. It may, however, be maintained that Iceland and the submarine ridge rose, while other areas remained undisturbed, but the absence of reptiles, batrachians, and all the higher mammals is opposed to this view, which, moreover, is unsupported by geological evidence.

ASIA.

Physical History of the Kishon and Jordan Valleys.—Prof. Bonney gives a note in the *Geological Magazine* for December, 1904, on the mode of origin of the present features of the Kishon valley and adjoining districts in Palestine, which presents a somewhat difficult problem. A broad trench, he points out, has been cut in the limestone highlands of Palestine to a depth of 1000 feet, and is now occupied by the plains of Acre and Esdraelon, the latter branching eastward into two arms, separated by Jebel Duhy or little Hermon, but maintaining their trench-like form, and cutting through the limestone isthmus which must once have united Samaria and Galilee. This trench is obviously a river-valley, but it is on much too large a scale to have been excavated by the present Kishon system. Such a task seems to necessitate not only a heavier rainfall, but also a much larger drainage area than now exists. The trench is obviously a beheaded valley, the two streams which descend to the Jordan on either side of Jebel Duhy having trespassed westward owing to their more rapid fall, and pushed the watershed in that direction. Thus, in Prof. Bonney's opinion, the Kishon valley is older than that of the Jordan, and still retains its ancient character to the west of the passes. The original stream must have been little less important than the Jordan itself, and its watershed would seem to have lain far to the east on the Syrian highlands. The movement by which these were first raised would thus have culminated in an axis still indicated by the headwaters of the Jarmuk, Zerka, and other streams, which formerly made their ways, by a limited number of outlets, westwards to the Mediterranean. Prof. Bonney also discusses the origin of the Jordan valley, to which he considers the term "rift-valley" to be inappropriate, and substitutes the more suitable term "trough valley."* He holds to the view that the watershed

* When the evidences of fracture are more obvious in the valley-sides, as in East Africa, he would be more ready to allow the term "rift-valley" to stand, and here, it is to be feared, it has become too firmly established to make way for a term that would be less liable to misconception. The origin of the word is often ascribed to Prof. Gregory, but we believe that that writer adopted a term already in use locally.

between the Dead sea and the Gulf of Akabah is not an original feature, but that a connection between the two did exist formerly.

Peter I. Range, Russian Central Asia.—The latest number of the *Izvestia* of the Russian Geographical Society (1904, 1 and 2), which is only just now out, contains an article by Lieut.-Colonel Novitskiy about his exploration of the Peter I. range. An immense area, thickly covered with snow-fields and glaciers, was discovered in this range in its eastern part, between the Muk-su and the upper course of the Khingu. It is beautifully seen from the top of the Gardanikaftan pass (12,800 feet high), and was explored by one of the members of the Lipskiy expedition. The main result of these explorations and the extensive survey which was made is to fully establish the fact that the Peter I. range is a south-western continuation of the Trans-Alai range, and represents, like this last, the border range of the great Central Asian plateau.

Northern Tobolsk.—The same number of the *Izvestia* contains an elaborate sketch of the northern parts of the government of Tobolsk and its inhabitants by A. A. Dunin-Gorkavich, who has spent thirteen years in this part of Western Siberia. This territory, which covers 367,300 square miles, continues to be represented on our maps as a blank, or as an immense marsh. It now appears, from a map of this region, on a scale of 1 : 680,000, which is given by the author, that a wide plateau, which rises about 100 feet or more above the general level of the land, covers the space between the Ob and the Irtysh; the remainder is occupied by tundras in the north, and forests elsewhere—marshy in the lower parts, and dry on the above-mentioned plateau. The population of this wide territory is only 35,000 souls, consisting chiefly of Ostyaks—who occupy, together with Voguls, the woody parts of the region—Samoyedes in the far north; a few Zyrians; and some Russians settled along the courses of the rivers. We find in the same number papers on the water reservoirs of the upper Volga, by I. V. Bushmakin; on pendulum observations in the Urals, by D. I. Dubyago; and on astronomical work in the same region, by B. Savelieff.

France and Siam.—The treaty between France and Siam, which has been the subject of so much discussion during the past three years, was at last ratified in its amended form at the close of last year. It will be remembered that a first treaty was signed in October, 1902, but that the outcry raised against its provisions by the French colonial party was such that it was withdrawn by the French government without being presented for ratification. A new treaty was negotiated, and this was signed on February 13, 1904, its general provisions being noted in the *Journal* for the following May (vol. **23**, p. 684). On June 29, 1904, a further convention was signed, by which the original treaty was once more modified in certain directions. The most important provision is that by which the frontier between the Tonle Sap (great lake) and the Gulf of Siam is laid down. The line follows a number of small rivers and, finally, a chain of mountains running down to the sea at Cape Lem-ling, the result being to supply a natural frontier, and to give to France the port of Krat and the adjoining territory on the south. Another provision of the supplementary convention rectifies the frontier of the protected state of Luang Prabang, to which Siam makes over small areas both in the south and north. The terms of this convention are printed at length in the *Révue Française* for January, 1905. The territory yielded up by Siam to France in the Krat district was formally handed over during the last days of 1904, and eight days later the Siamese territory of Chantabon, which has been occupied by way of pledge during the whole course of the dispute between the two countries, was evacuated by the French troops. A commission for the demarcation of the boundary on the spot has already commenced operations in the Krat region, the

head of the French party being Commandant Bernard. The frontier in the Bassac region will be fixed later on, after the conclusion of the summer and autumn rainy season.

Korea in Early Maps.—M. A. Pawlowski has attempted to sketch the history of the cartography of Korea in a paper printed in the *Bulletin* of the Rochefort Geographical Society (1904, No. 3). The sketch is far from complete, and is marred by some inaccuracies, but a few points of interest may be noted. It is somewhat singular that many of the earliest maps of the extreme east of Asia show a peninsula in this region, though M. Pawlowski makes a very doubtful assumption when he regards this as possibly representing Korea. The first vague indication of such a peninsula might, in fact, be traced back to the map of Martellus Germanus (about 1489), to which he makes no allusion. The more pronounced form which it takes in the 1511 map of Bernardus Sylvanus, and its still greater development in the "Nordensköld gores" (to which also no reference is made) and Bordone's rough map of 1528,* can likewise be hardly the result of definite knowledge. During the middle of the sixteenth century the knowledge of this region continued exceedingly vague, and the 1570 "Theatrum" of Ortelius (unaccountably ascribed to Mercator in the article) gave no indication of the Korean peninsula, while Mercator gave the name to an island. M. Pawlowski ascribes the first definite advance to Linschoten, whose map, he says, shows the first proper appreciation of the general form of Korea, though still leaving the question of its connection with the continent undecided. It is not quite clear in what direction Linschoten's map shows much advance on that of Mercator, or on that of 1595, issued with the later editions of Ortelius, the materials for all these having evidently been much the same. The 1595 map, which embodies the information collected down to that time by the Portuguese, was the work of "Ludoico Teisera." One of the first maps to show Korea correctly as a peninsula was the Hakluyt map of 1600, but the old delineation as an island was adhered to in Holland and elsewhere until some time later. In later times a great improvement was due to the information sent home by the French Jesuits, and published by D'Anville, to which, however, M. Pawlowski devotes little attention, while giving full credit to the contribution of Strahlenberg, in his large map of 1730. The work of La Pérouse, Broughton, and Krusenstern brings us down practically to modern times.

AFRICA.

The Alexander-Gosling Expedition.—We have received further news of this expedition, dated "Kadde, Lake Chad, December 27, 1904" (cf. *Journal*, vol. **24**, p. 589; vol. **25**, p. 176). The sad death of Captain Claude Alexander, which had naturally cast a gloom over the whole expedition, had occurred on November 13, at Maifone, whither he had been taken on falling ill with enteric fever. The case had been hopeless from the first. The survey party under his charge had had some hard times owing to the rainy season, difficulties of transport, and scarcity of food, but no efforts were spared to carry out the mapping operations in the best way possible. Eventually the survey was continued under favourable circumstances up to Kuka, a connection having thus been made between Ibi and that place, *viâ* Bauchi and Gombe, by a line of latitudes and azimuths up to the frontier of Bornu, and afterwards by a rigorous traverse. Since arriving at Kuka the leader and Mr. Talbot had carried out a trip on Lake Chad, making a sketch-map

* The somewhat similar delineations of a peninsula by Mercator (1538) and by Gemma Frisius (1551) have a different origin, being evidently modifications of the great south-eastern peninsula of earlier maps, itself a survival of the Ptolemaic influence.

of the portion visited. From Lieut. Alexander's account, it appears that the configuration noted by French officers on the eastern side of the lake extends also to the west, the whole of the portion navigated being filled with a network of islands. Starting from Kadde, which is close to the lake and about 20 miles north of Kuka, the explorers went north-east to a point about 30 miles due east of the mouth of the Yo river. It had been impossible to proceed south-east, owing to the many belts of marshy islands half under water. The majority of these are from 1 to 5 miles in length, with a sandy, shelly soil. They are covered with short coarse grass, with occasional belts of high reeds or low bushes. The Maria bushes, of which thick belts were seen fringing the lake-shore south of Kadde, were not, however, observed on the islands. On several islands collections of low deserted grass huts were seen, but it was impossible, throughout the journey, to get in touch with the Budduma, who always fled on the approach of the white men. They seemed to possess large herds of cattle, and have numbers of canoes made of dried reed-stalks tied together in layers. These are picturesque in appearance, being in shape like the Venetian gondola. Soundings were constantly taken, and the depth of the lake found to be almost uniformly from 1 to 1½ foot, though between the Yo mouth and Kadde it reached 2½ to 4 feet. The bottom is shelly and sometimes firm, but more usually consists of soft black mud. The wind, which is generally north-east, appears to influence the level greatly, a fall of 10 inches being on one occasion observed in a single night. Owing to the shallowness of the lake and the many islands, it was found impossible to take the expedition across to the Shari mouth, so the bulk of the expedition was to go round through the Kotoko country. Lieut. Alexander hopes, if possible, to push on to the south-east through the little-known region between the Shari and upper Nile, returning by the east coast. A few additional details are contained in a letter from Captain Gosling, who says that the Yo is a wonderful little river, being at high water at Yo in December, while all the surrounding country was dry and burnt up, the scanty rains having ceased about August. Mr. Talbot, whose aid in the survey work is said to have been invaluable, has returned home, bringing with him the map so far as completed. Altogether an excellent piece of work seems to have been accomplished.

Flint Implements from the Fayum.—Mr. H. W. Seton-Karr sends us a short printed description of the flint implements discovered by him in the Fayum during his expedition in October, 1903. It includes an extensive series of illustrations (both drawings and photographs) of the principal objects found, which will be useful as giving a comprehensive view of the whole collection previous to its distribution among widely separated museums. The objects are found, not only along the border of the ancient lake, but on any ground in the vicinity where there are no sedimentary deposits or superimposed material from the weathering of cliffs, etc., or from sand drift; provided that material was available in the form of flint and agate boulders, and that settlements of pre-historic man existed in the neighbourhood. The first condition is met on the summits of undulations where the prevailing north wind keeps the sand from settling, especially on the north sides. Mr. Seton-Karr thinks that implements of many different epochs are mixed up on the surface of the Fayum desert, and, while not stating definitely that any are of Palæolithic age, holds that man existed here during the glacial epochs. Among the implements not figured are some mealing-stones or corn-grinders, and a series supposed to be fish-scaling knives, representing a type peculiar to the Fayum, which has been placed in its entirety in the Cairo Museum. The objects figured include arrow and lance heads, saws, borers, knives, axe-heads, as well as many of uncertain use; some crescent-shaped, others apparently to serve as adzes, etc., etc. Some of the types appear to be unique.

Northern Territories of the Gold Coast.—The report of Lieut.-Colonel A. Morris on the Northern Territories of the Gold Coast for 1903 (Colonial Reports, Annual No. 429) shows that the general condition of the protectorate is satisfactory. A station was established at Salaga in June, 1902, and has led to a great influx of trade and to a considerable increase in the caravan tax. The general health of Europeans in the protectorate is good, the climate of the Northern Territories, in Colonel Morris's opinion, being much superior to that of the coast. Salaga is apparently the most unhealthy, while Gambaga has the healthiest record. Considerable progress has been made during the year in mapping the protectorate. The greater portion of the Kintampo district has been sketched, as well as the country extending from Gambaga nearly 40 miles to the south and west; the north-western portions of the Black Volta district lying between 10° and 11° N. lat., and 2° and 2° 45′ W. long.; and the Volta from Yeji to Wuyima. Sketches on a large scale have also been made of the environs of Gambaga, Salaga, Wa, and Kintampo, to a radius of five miles. The protectorate appears suitable, both as to soil and climate, for the cultivation of cotton, and the success of this commodity as an article of export seems to mainly depend on the facilities of transport; the best districts, therefore, for growing cotton would be in the immediate vicinity of the Volta river. The cost of transport has been considerably reduced since the opening of the Volta River Transport Service, but is still very high. Two new roads have been completed—the permanent road between Gambaga and Salaga *viâ* Patenga and Khobia, 150 miles long and 16 feet wide, and a road from Wa to Gambaga, joining the old main road from Gambaga at Bimba.

Railways in British West Africa.—A Bluebook issued in December, 1904, reports that there were then in full working order 135 miles of railway (2 feet 6 inches gauge) in Sierra Leone, and 87 still in course of construction; 125 miles (3 feet 6 inches gauge) completed in Lagos; and 170 completed in the Gold Coast, making altogether 430 miles completed in the three colonies. In the case of all three railways the construction has been carried out tentatively by sections, a policy framed with a view to the general interest of each colony rather than to rapidity of construction. The difficulties of railway construction in West Africa include the want of landing facilities, sickness of the staff, excessive rainfall, obstruction caused by the dense tropical forest, and the necessity of carrying on the entire work and conveying all the materials from one base. In Sierra Leone, the first 32 miles of line running eastwards from Freetown to Songo Town was completed in December, 1898; the next 23 to Rotifunk in March, 1900; the next 80 to Bo in October, 1902; while of the 87 miles of the Bo-Baiima section, 51½ were completed in February, 1904. A local line to meet the needs of officials residing on the salubrious heights above Freetown, and necessitating steep gradients (1 : 23) for a large part of the route, was completed and opened on March 1, 1904. In Lagos the railway line of 125 miles, from Lagos Town to Ibadan, has been in running since December, 1900. It includes the Denton Railway Bridge from Iddo island to the mainland. A short branch, 1½ miles long, from Aro across Ogun river to the gates of Abeokuta, has also been constructed. The bridge across the Ogun is 549 feet long. The Gold Coast line, from Sekondi to Kumasi, was completed in September, 1903.

Surveys in South Africa.—The report of the astronomer at the Cape for 1903 announces the completion of the field-work and computations relative to the survey of the Anglo-German boundary of South-West Africa, while the reduction of the geodetic survey of Southern Rhodesia is also completed. Operations in connection with the measurement of the arc along the 30th meridian from the Zambezi to Lake Tanganyika, under the direction of Dr. Rubin, were in progress

during the year, but owing to grass fires little could be done beyond reconnaissance, beaconing, and astronomical observation. A site for a base line was selected on a plain alongside the river Loangwa, near its intersection with the 15th parallel of latitude. Under the superintendence of Colonel Morris, geodetic operations in the Transvaal and Orange River Colony commenced in January, 1903. This survey will embrace the following series: Newcastle (Natal) to the Limpopo (along the 30th meridian), 415 miles; Limpopo to Ottoshoop, 230 miles; Belfast to Ottoshoop, 240 miles; Newcastle to Christiana, 220 miles; Ottoshoop to Kimberley, 245 miles; Pretoria to Cala (through Kroonstad), 405 miles; Hopetown to Natal (through Wepener), 320 miles; Newcastle along 28th parallel to the sea, 140 miles;—the whole representing a chain of triangulation of approximately 2215 miles. As a result of Lord Milner's endeavours for the creation of a topographic survey of British Africa south of the Zambezi, we learn that the Transvaal and Orange River colonies have provided an organization sufficient to complete the principal triangulation of these colonies in three or four years, and to make connection with the systems of principal triangulation in the Cape Colony and Natal. It is also proposed to carry out the triangulation through Basutoland and the portion of Zululand annexed to Natal, the cost to be defrayed by the Governments concerned. Thus, it is shown, the whole of British South Africa, with the exception of Bechuanaland, will be on an equality in the matter of survey, should the Government of Rhodesia agree to the connection of Gwelo with the Geodetic system south of the Limpopo.

The Madagascar Railway.—With a view to celebrating the inauguration, on November 1 last, of the opening of the first 102 kilometres (63 miles), between Brickaville and Fanovana, of the railway which, when completed, will connect the port of Tamatave with the capital of Madagascar, the *Revue de Madagascar* (6e Année, No. 12) devotes some fifty pages to a consideration of the whole line, that still in construction as well as that opened, and gives an interesting running description, geographical and geological, of the country the line passes through. Leaving Tamatave, a short coast railway runs to Ivondro. Thence the route runs south, through coast lakes by a canal to Brickaville, at the confluence of the Vohitra and the Ronga-Ronga, 9 miles in a bee-line from the coast. Two years ago a village of twenty huts, Brickaville has now, besides its station, a hotel-buffet with twenty rooms for travellers and two wings for accommodation of soldiery *en route*. Thence the railway skirts the Vohitra, traversing flat lands abounding in bananas, ravenalas, and mangoes. Sixteen kilometres from Brickaville the line reaches the station Aniverane, the capital of a district where are quartered the railway management and principal offices, houses for the staff, stores, engine sheds, repairing shops, coal, water-supply, etc. Thence the railway bends west, still following the river and penetrating a rugged region, such as is characteristic of many parts of the island. The first rapids are seen between the 18th and 19th mile. At Fanosana (28 miles) the line leaves the Vohitra to traverse a valley and strike the chain of Vonga-Vonga, which it penetrates by a tunnel of over 800 yards. The bed of the river to which, at 32 miles, it returns, becomes more rugged, the vegetation thinner, and the scenery wilder. This bed it ascends, now closely edging the river, and now boring its way among isolated hills. At 51½ miles the line finally leaves the Vohitra. It was at Fanovana, the present terminus of the line, that the banquet of inauguration was held. Trains leave Brickaville every Wednesday and Saturday; a first-class ticket costing 40.80 fr., a second half that price.

New Arrangement with Italy respecting East Africa.—By a convention between Great Britain and Italy, signed on January 13 last, a small piece of

territory has been made over to Italy immediately north of Kismayu, the motive being to give to the southern part of Italian Somaliland a better outlet than it has hitherto possessed. A strip of land connecting the port with the trade route to Lugh, on the Jub river, has at the same time been leased to Italy. Sovereign rights have also been acquired by the latter over the portion of the coast hitherto held by a ninety-nine years' lease from the sultan of Zanzibar. This territory, which has hitherto been administered by a chartered company, will in future depend directly on the Government.

The Usambara Railway.—This railway in German East Africa, which halted so long at its first terminus at Korogwe, is now being carried further into the interior, and has reached Mombo, some 30 miles north-west of the former place, the new section being formally opened on February 19. The *Deutsches Kolonialblatt* for March 1, which supplies this information, gives a map showing the route of the railway from the port of Tanga to Mombo. Between Korogwe and this place it skirts the western side of the Usambara highlands.

AMERICA.

Two New Canadian Provinces.—A bill authorizing the creation of two new provinces in Central Canada was introduced on February 21 before the Canadian legislature. According to its provisions, the provinces will be named Saskatchewan and Alberta, but the limits will be considerably wider than those hitherto assigned to the territorial divisions of those names, Assiniboia and Athabasca, as well as a portion of the north-west territory, being apparently absorbed into the new provinces, which will, together, extend from Manitoba to the Rocky mountains, and from the United States frontier to the 60th parallel. This vast area will be divided into two almost equal parts, each with an area of about 225,000 square miles. Each province will have a legislative assembly of twenty-five members, and the capital of Saskatchewan will be Regina, that of Alberta being temporarily located at Edmonton until a final decision is arrived at by the legislature. It is hinted that the provinces of Quebec, Ontario, and Manitoba may all be extended northward to the shores of Hudson bay. The date proposed for the creation of the new provinces is July 1 of this year.

The Glaciers of Alaska.—Prof. George Davidson has carried out an interesting study of the glaciers of Alaska, as shown on Russian charts or mentioned in the narratives of early explorers, with a view to elucidating their subsequent movements of advance or retreat by comparison with the statements of recent authorities. Of the Russian charts those of Tebenkof (1852) are of course the most important, though themselves based largely upon the surveys of Vancouver and others, and they have been taken by Prof. Davidson as the basis for his study. The earlier travellers include (besides Vancouver) La Pérouse, Malaspina, Whidbey, Belcher, Lütké, etc.; while from more modern times the writer has studied the works of Blake (1863), Muir (1879 and after), Abercrombie (1884, 1898), Reid (1890), Russell (1891 and later), Klotz (1893–94), the Harriman Expedition (1899), and several others. He finds that the glaciers shown by Tebenkof on his charts number thirty in all, while those for which there is no Russian authority number about one hundred. The former are so characteristically shown that there is no possibility of misreading them. Beginning from the Aleutian islands in the west, Prof. Davidson takes the whole series of glaciers in order, describing each in turn as observed by its chief investigators. He has also drawn a useful series of eleven charts, on which he has shown both the original Russian delineation and important recent changes. Some of the most interesting of these are to be seen at the head of Yakutat bay, where Malaspina's chart of 1791 (reproduced by Dr. Davidson) shows

the ice as reaching well below the termination of Disenchantment bay (which it therefore completely masked), while at the present day the open water extends so far up that some of the branches of the original glacier are now quite independent, as shown by recent Canadian reconnaissances. Summing up, Prof. Davidson shows that there seems to have been a general recession of the glaciers through the Aleutian islands, the Peninsula of Alaska, and from Cook's inlet to Portland canal, except where they come directly or almost directly upon the broad ocean. Evidences of advance are shown, among others, by the Malaspina glacier, which has filled and obliterated the icy bay of Vancouver and Tebenkof; by the glaciers of Lituya bay, which have shortened the deep arms described by La Pérouse; and by the La Pérouse glacier upon the ocean shore. It is, however, in this very region of advance that the ice has retreated, as above mentioned, from the head of Yakutat bay. In conclusion the writer urges the importance of systematic observations on the climatology of the whole region in question, at well chosen stations.

Dome Structure in the Sierra Nevada.—In the January number of the *Sierra Club Bulletin* there appears an article by Mr. G. K. Gilbert (originally printed in the *Bulletin* of the Geological Society of America for February 10, 1904) on the dome-like forms which characterize so many of the summits in the granite areas of the Sierra Nevada. Discussing the two theories according to which such forms are due, (1) to original structure, antedating the sculpture of the country and determining the peculiarities of form; (2) to some reaction from the surface, which induced the observed structure subsequently to the origination of the form; he finds that the latter explanation fits in better than the former with the facts of the case. The dome-structure is not found in rock which is divided by systems of parallel plane joints, for in large areas where the granite is so divided into angular blocks the domes are not met with. On the other hand, where there is but a single set of division-planes, and where disintegration is therefore retarded, the granite masses stand out as prominent dome-shaped hills. The structure resembles the exfoliation caused by the effects of expansion or contraction, such as, *e.g.*, are produced by a forest fire, or by the cooling of a lava-stream, and it is expansion that seems the more probable cause in the case of the domes. It may, Mr. Gilbert thinks, be the result of dilatation following on the unloading of a deep cover of older rock. The rounded form of the domes tends to become more and more pronounced as each successive layer is removed, the departures from strict parallelism between the surfaces of partition being such as to reduce or omit angles and other features of irregularity, so that the inner partings reflect only the general features of the external sculpture. In opposition to these forces, corrasion has worked also in this region, and one of its most conspicuous traces is to be seen in the mountain known as Half-Dome, the base of which was sapped by glacial corrasion, and a part of the mountain was thereupon sheared off by gravity, leaving a flat vertical face, in which the "dome-structure" was afterwards developed, the new partings being here plane, and simulating ordinary joints.

AUSTRALASIA AND PACIFIC ISLANDS.

Flora of the Islands south of New Zealand.—The flora of the small islands dotted over the ocean to the south of New Zealand (Auckland, Campbell, Antipodes, Bounty, etc.) presents some interesting problems in connection with the subject of the distribution of plants over the southern part of the southern hemisphere. These islands, while showing many floral affinities with New Zealand, have this in common with the rest of the ring of small islands which encircles the globe in these latitudes, that they contain an element to which the name "Fuegian"

has been given by botanists. Our knowledge of the flora of these islands (to which one of the earliest and most important contributions was made by Sir Joseph Hooker during the Ross Antarctic expedition) has lately been extended by the researches of Dr. L. Cockayne, who, in 1903, visited most of the groups on board the *Hinemoa*, one of the boats sent periodically by the New Zealand Government in search of possible castaways. His visit was of interest from the fact that it was made in winter, while all previous botanical observations had been made in spring or summer. The results obtained are communicated at length in vol. 36 of the *Transactions and Proceedings of the New Zealand Institute* (Wellington, 1904). Dr. Cockayne gives a sketch of the geology, climate, etc., of all the islands visited, and treats at length of the principal plant-formations represented in each, concluding with some interesting general remarks on the history and affinities of the flora as a whole, and the modifications to which it has or is likely to be subject through external agencies. The general character of the climate of all the islands seems to be marked by cloudy skies, frequent showers, a mild temperature in winter, but a cool summer, with, finally, furious gales and squalls with hail or sleet, of the effect of which the aborescent flora bears abundant evidence. One of the most remarkable of the formations represented is the "Rata-forest" of the Auckland group, in which *Metrosideros lucida* is the dominant tree. It forms a belt, sometimes of great luxuriance, round a large part of the coasts. The physiognomy and interior contents of this forest are the resultant of two opposing factors, the one tending to produce a xerophytic, the other a hygrophytic flora. From its moisture and equable nature the climate would be an ideal rain-forest one, but as opposing factors we have the low summer temperature and the furious winds. These last have led the trees to form a dense flat roof of foliage, with a luxuriant lateral growth of the branches, and beneath this canopy the hygrophytic factors can exercise full sway, as shown by the abundance of filmly ferns, liverworts, etc. Another type of forest is that of *Olearia Lyallii*, which occurs locally only, but grows with great luxuriance, so that there seems no reason why it should not be the dominant forest of the southern islands. Possibly the case is one where a very slight change of conditions has caused an older formation to be ousted by a newer one. As regards the effect which introduced animals have had on the flora, this is principally to be observed in Campbell's island, where sheep-farming is now an accomplished fact. Taken as a whole, the flora consists of the following elements: Of the flowering plants, 39 per cent. are endemic; 18·8 per cent. Fuegian (including 5 per cent. which do not extend to New Zealand); and 42 per cent.* New Zealand, excluding those also Fuegian. Of the plants which extend to New Zealand, nearly half are mountain plants, while the remainder includes plants of a forest which ascends to the sub-alpine region, or grows under more or less alpine conditions. The presence of the Fuegian element is, in Dr. Cockayne's opinion, rather to be explained as due to former land connections than to the agency of birds, winds, currents, etc., and this is borne out by the occurrence of the Rata forest—a distinct plant-formation such as might be found in many parts of the south island of New Zealand.

A Magnetic Survey of the North Pacific.—Prof. L. A. Bauer contributes to *Nature* of February 23 last some account of a magnetic survey of the North Pacific ocean to be commenced during the present year under the auspices of the Carnegie Institution, which has made an initial allotment of $20,000 to cover the first year's expenses. Prof. Bauer points out the reasons which make such a survey eminently desirable, and quotes the opinions of Captain Creak, Prof.

* Dr. Cockayne's figure is 43·1 in this case, but this is a miscalculation.

Schuster, and Mr. O. H. Tittmann, in favour of the inception of the work. Our knowledge of the distribution of the magnetic forces over the oceanic areas—that is, over the greater portion of the Earth's surface—is extremely defective, the existing charts depending—apart from comparatively few and isolated data—on observations made on islands or along the coasts, which are liable to be affected by local disturbances. The plan of the survey has been worked out by Mr. G. W. Littlehales, and involves the purchase of a wood-built, non-magnetic sailing vessel of about 600 tons displacement, which, starting from San Francisco, shall pursue a spiral course of about 70,000 nautical miles, embracing eventually the entire North Pacific ocean. The course, which has been chosen so that the best advantage may be taken of meteorological and other factors, will lead in succession through each of the five-degree quadrangles in which values of the three magnetic elements will need to be obtained; the first circuit leading round the periphery of the North Atlantic *viâ* the Galapagos, Philippines, and Japan, while the second will lead through the series of quadrangles lying next on the mid-ocean side of that previously traversed, and so on. The region contains sufficient magnetic observatories to supply the necessary corrections for reducing the observed magnetic elements to a common epoch, continuous records being available from Sitka, Mexico, Honolulu, Manila, Shanghai, and Tokio, while it is hoped that there may soon be another such in or near California, and that the German station in Samoa will be maintained during the course of the survey. It is thought that opportunity will be afforded by the survey of studying the effect of the configuration of land and water upon the distribution of the magnetic forces, as it is to be expected that distortions and anomalies will be revealed in the neighbourhood of islands and coasts. The first circuit will be particularly interesting from this point of view. It is hoped that three years will suffice for the entire work of observation and reduction, and that similar work may be in time undertaken for other oceanic areas.

POLAR REGIONS.

The French Antarctic Expedition.—Dr. Charcot's expedition, to the expected return of which reference was made in our last number, arrived in safety at Puerto Madryn, in the Chubut territory of Patagonia, on March 4, and any uneasiness that may have been felt owing to the return of the Argentine gunboat *Uruguay* without tidings of the party has therefore been quickly allayed. As we pointed out, however, in referring to the report of the *Uruguay's* commander, the failure to find traces of the expedition in the latitude reached by that vessel gave really no ground for alarm. A telegram has been received in Paris giving a few details as to Dr. Charcot's experiences, which are reproduced in the February number of *La Géographie*. The *Français* wintered at Wandel island, at the southern extremity of Gerlache (formerly Belgica) strait, in 65° S. Thence an expedition to the south settled the question of Bismarck strait, the western end of which was discovered by Dallmann in 1874, but the exact character of which had been hitherto in doubt, as its communication with the sea on the eastern side of Graham Land had not previously been demonstrated. The French expedition has also laid down the contours of the west coast of Graham Land, landings being effected at several points, and of the "Palmer archipelago," by which Dr. Charcot seems to understand the islands separated by Gerlache strait from the main land-mass. It also pushed south-west within sight of Alexander I. Land, but the impenetrable ice-pack prevented it being reached. On the coast of Graham Land the *Français* ran aground and sprung a serious leak, but this danger was happily overcome. The expedition appears to have made some useful additions to our knowledge of these southern regions.

GENERAL.

An Interesting Chronometer.—Through the kindness of the Secretary of State for India, the Society has recently received an interesting addition to its collection of relics of early explorations. This consists of a ship's chronometer, which was used by Captain J. Parry on board H.M.S *Hecla* on his voyage in the Arctic Regions for the discovery of the North-West Passage in 1824, and which was subsequently used on board H.M.S. *Volage* during her voyage round the world, 1826–29. Previous to being taken over by Captain Parry, the chronometer had, in the same year, gained the first prize at Greenwich, its variation for a period of twelve months being only 1·11 second. During both the voyages referred to its performance was such as to merit the unqualified praise of the captains and officers of both ships. The chronometer has lately been deposited in the Indian Government Stores Depôt, and the Secretary of State, thinking it would be of interest to our Society, has kindly given permission to have it handed over to us.

Geography at Cambridge.—The new regulations proposed by the Board of Geographical Studies at Cambridge, and recently adopted by the Senate, mark an important step forward in the cause of geographical education in this country. The regulations have to do, firstly, with the Special Examination in geography for the ordinary B.A. degree, which will in future be held twice a year, like others of the undivided Special Examinations; and, secondly, with the Examination for the newly instituted Diploma in Geography. The first-named will be both in writing, and oral and practical, and will have reference to the following subjects: Physical, Historical and Political, and Economic Geography, and Cartography, with (as voluntary subjects) the History of Geographical Discovery and the Elements of Ethnology; six papers, one for each of these subjects, being set. The examination for the Diploma in Geography will be in two parts, Part i. being identical with the Special Examination, while candidates who have passed the examination under the one name will be held to have passed also under the other. Part ii., which can only be taken by those who have already satisfied the examiners in part i., includes subjects which are to be treated in an advanced and comprehensive manner. They will be: (*a*) Regional Geography, (*b*) Surveying and Mapping, (*c*) Geomorphology, (*d*) Oceanography and Climatology, (*e*) History of Geography, (*f*) Anthropogeography. Of these all candidates will be required to take (*a*) and (*b*), together with two at least of the remainder. The range and contents of the six subjects have been subsequently defined by the Board. There is, naturally, a certain amount of overlapping between some of the subjects, Regional Geography being the most comprehensive, and having to do with portions at least of several of the other more special subjects. The first examination under the new scheme will be held in the Easter Term of the present year.

The Oxford School of Geography in 1904.—The attendance of students during the three terms in 1904 has been 117, 141, and 146 respectively, as against 137, 104, and 115 in 1903. A large proportion of the students still attended the Reader's lectures only, but the number of those receiving practical instruction rose from three in the Hilary term to eight in the Michaelmas, which is a satisfactory feature. Several graduates were students of the school, which was attended also by visitors from the United States, Germany, Italy, and Egypt. The scholarship for 1904–5 was awarded to W. J. Barton, B.A., Scholar of New College; and the diploma was gained by Miss M. E. MacMunn. The equipment continues to be improved by purchases and gifts, and the collection of large-scale maps of Central Europe and the British Isles is an extensive one. At the Vacation course, held from August 2 to 16, thirty students attended.

The Fourteenth Congress of Orientalists.—As already announced (*Journal*, vol. 23, p. 792) this Congress will meet at Algiers at Easter of this year. A circular has been issued, giving practical information as to hotels and lodgings (of which a good supply is available), and as to the days of sailing of various lines of steamers and the rates of reduction allowed. The titles of communications intended for reading at the Congress will be received up to the day before the opening meeting.

OBITUARY.

The Earl of Southesk.

THE death occurred on February 22 last, of the Right Hon. the Earl of Southesk, K.T., who had been a Fellow of our Society since 1860. The deceased peer, who was born in 1827, was eldest son of the late Sir James Carnegie, whom he succeeded as sixth baronet of Pitbarrow in 1849, having previously served successfully in the Gordon Highlanders and the Grenadier Guards. In 1855 he succeeded in establishing his claim to the Earldom of Southesk, which had been forfeited by the fifth earl for the part which he took in the rebellion of 1715. Lord Southesk was well known to geographers for his extensive travels in the north-west of North America nearly half a century ago, during which he traversed some of the wildest and least-known portions of the Rocky mountains, about the sources of the Athabasca and Saskatchewan (cf. *Journal*, vol. 13, p. 546). He described these travels in an interesting work entitled 'Saskatchewan and the Rocky Mountains,' published in 1875. His youngest son was the late Hon. David Carnegie, whose excellent work in Australia and Nigeria is well known to readers of the *Journal*.

Stephen William Silver.

With sincere regret we have to record the death of Mr. S. W. Silver, one of the Society's oldest and most esteemed Fellows, who died at his country seat, Letcomb Manor, Wantage, on the 7th inst.

Until about a month ago, our old friend and associate was travelling regularly to London to attend his various Board meetings, and his health seemed to indicate that he would continue with us some years longer. In February he caught cold on the lungs, and was confined to his house at York Gate for two or three weeks. A man full of energy, he apparently made a quick recovery, was permitted to return to Letcomb, but had a relapse, and passed away, after a few days' illness, at the ripe age of eighty-five.

Born in London in 1819, Mr. Silver succeeded, in 1846, to the management of the export and banking business founded by his father, a business having its agents and correspondents in all parts of the world. S. W. Silver & Co.'s monthly *Circular* soon merged itself into an *Emigrant's Guide;* that in time expanded into a Series of Handbooks to each group of colonies in Australasia, Canada, South Africa, and the West Indies; while to these publications was added the fortnightly, afterwards weekly newspaper, the *Colonies and India*, now extinct.

After his retirement from the City business, Mr. Silver continued for many years chairman of the India-rubber and Telegraph Company, having its works at Silvertown. He was also a director of the London Life Association, a Past-Master

of the Ironmongers' Company, and a Deputy-Lieutenant of the City of London; Governor of St. Thomas's, St. Bartholomew's, and Bridewell Hospitals; Fellow of the Linnæan, Botanic, Zoological, Colonial, and Bible Societies, as well as the Geographical: in all he took a very active interest.

Elected a Fellow of our Society forty-six years ago, it was not long before he was sitting at the Council table with Sir Henry Rawlinson, Lord Houghton, Admiral McClintock, Prof. Huxley, Clements Markham, Sir Bartle Frere, and other noblemen and gentlemen, Sir Roderick Murchison presiding. He was again and again re-elected to the Council, for his business experience was invaluable, particularly in matters of finance. He also served on the Library and Reception Committees.

Without any pretence as a scientific geographer, Mr. Silver was yet well informed upon the progress and results of modern exploration. Few men could follow the course of a traveller more intelligently; indeed, he was minutely acquainted with the routes of African explorers, and intimate with Livingstone and Moffat, Burton and Speke, Baker and Consul Petherick, Cameron, Holub, Selous, Thomson, and many more. One was always certain of meeting visitors from different parts of the world at his table, either at his club or at his town house, York Gate; a favoured few were made welcome at the "Benhams," Letcomb, where Mr. Silver was long privileged to exercise the influential position of a "lord of the manor." To not a few travellers he gave useful advice, and where necessary extended a helping hand. Joseph Thomson, returning home in a dying condition, spent his last days at York Gate. There Mr. Silver had collected his valuable geographical and colonial library, which was always accessible to visitors and searchers. He considered himself amply repaid by the use young students made of the collection, and was more than gratified when the printed catalogue found its way into some of the principal libraries as a work of reference.

Modest and unassuming, and unostentatious in all his doings—it was only upon very rare occasions that his voice was heard—Mr. Silver took a personal interest in the welfare of every one with whom he associated. He will be missed far beyond his own immediate circle of friends, which is a very large one, and remembered for his kindly and agreeable manner by all who came in contact with him.

E. A. P.

Gabriel James Morrison.

In Mr. Gabriel J. Morrison, M.I.C.E., M.I.E.E., who died in London on February 11, at the age of sixty-four, the Society lost a member who throughout his life had taken a keen interest in geography, and a part, and that sometimes a leading part, in several of the enterprises in the latter part of the last century, which were the initial stages towards the development of new fields of science and of commercial activity.

In 1856–57, while attending the class of natural philosophy at Glasgow University, under Prof. Thomson (now Lord Kelvin), he devoted himself to the study of electricity, and to experiments in conductivity, insulation, etc., and early in 1858, when only eighteen years of age, was asked by Prof. Thomson to assist in electrical experiments, and, if necessary, in the laying of the Atlantic cable. This led to his sharing in all the adventures which attended that enterprise in 1858, and after the connection between England and Newfoundland had been established, he remained at the western station until the fading life of the cable expired in a last message from Mr. Morrison to Prof. Thomson.

On his return to Scotland he was principally engaged in railway engineering. In 1863 he joined the staff of Mr. (afterwards Sir James) Brownlees, and after acting as resident engineer on several railroads and public works, and preparing surveys of other railways both at home and abroad, left for China as engineer-in-charge of the railroad from Shanghai to Woosung, which it was expected would pave the way for the early extension of railroads throughout the country. The railroad was begun and completed in 1876, but encountered official opposition, and, after being sold to the Chinese Government, was torn up the following year.

Mr. Morrison stayed on in China in the vain hope that the attitude of the Chinese Government towards railway extension would change, and while practising as a civil engineer in Shanghai made many journeys in the country, surveying routes which were likely to be adopted. The most notable of these was in 1878, through the province of Hunan, which was at that time intensely hostile to foreigners. His experience there was most trying, but, in spite of being hooted from place to place, he travelled almost the whole distance on foot, in order to be able to conduct a rough survey.

But his connection with the Shanghai-Woosung railway was fatal to his employment in any similar enterprise favoured by the Government, though his advice in other matters, such as the closing of the breach in the Yellow river in 1888, was sought by Li Hung Chang. On this matter it is worth recording that he stated that the native methods had best be persevered in, and his opinion was justified by their success.

About 1880 he travelled in Cambodia, where he had an interesting interview with the king. And in 1883 he made several visits to Korea, which at that time had not yet been opened to foreigners, with a view to ascertaining its mineral resources, and the first foreign mining enterprise in that country was started in consequence of his investigations. In 1889 he travelled in Tonquin to examine some coal-mines.

After leaving Shanghai in 1902, he was associated with Sir J. Wolfe Barry as consulting engineer of the Shanghai-Nanking railway, which is now in course of construction, and thus before he died had at last the satisfaction of participating in the development of the enterprise which he so long had at heart.

A paper by him on "Journeys in the Interior of China" was read before the Society in 1880. Besides this he wrote numerous papers, *e.g.* "A Visit to and Description of the Island of Formosa," "Inland Communications in China," "Breach in the Embankment of the Yellow River," "Engineering in China," "A Trip to Corea," "Journeys from Hankow to Canton and from Chinkiang to Tientsin," which for the most part are to be found in the *Proceedings* of the Institute of Civil Engineers or in the local press of Shanghai. A paper on "Great Circle Sailing," read before the British Association at Belfast, was afterwards expanded by him in his 'Maps: their Uses and Construction,' published by Stanford. This work was extended, and considerably improved in the second edition, which appeared in 1902, and is now one of the most useful elementary text-books on the subject.

Mr. Morrison took an active part in the public life at Shanghai, where his services as colonel of the volunteer corps, and as municipal councillor, provoked a very hearty manifestation of esteem on his departure in 1902.

He was elected a Fellow of the R.G.S. in 1881, a member of the Institute of Civil Engineers in 1874, received the Watt Medal (1876), and was elected a member of the Institute of Electrical Engineers in 1884. He was also elected first president of the Society of Engineers and Architects in Shanghai, 1901.

W. R. C.

Prof. Eduard Richter.

Geography has sustained a severe loss by the death, on February 6 last, of Prof. E. Richter, of Graz, one of the best Continental authorities on the Alps and their glaciers, the scientific study of which was greatly furthered by his work and influence. This was, however, but a part of his many-sided contributions to geographical science, one of his most striking characteristics being the breadth of his outlook, which enabled him to give due weight alike to the physical and to the historical sides of geography, much of his most important work being concerned with the latter. Born in 1846, Richter became in time professor at the "Gymnasium" at Salzburg, where his first opportunities of studying the alpine glaciers were gained, their outcome being his first published work entitled 'Die Gletscher der Ostalpen' (1888). Another important field to which his energies were afterwards devoted was that of limnology, in which he did much to improve our knowledge, especially as regards the lakes of the eastern Alps. To him was due the first clear recognition of the strongly marked dividing-line between the warm surface water and colder bottom water of many lakes, and the term "Sprungschicht," now generally used in Germany to denote the level at which this fall occurs, was originated by him. Among the results of his investigations in this field may be mentioned his 'Seenstudien' (1897), which formed a commentary on the second part of the 'Oesterreichischen Seenatlas.' Other important works were his large work in three volumes entitled 'Die Erschliessung der Ostalpen' (1893–1894), and his study of the morphology of the Alpine peaks published in 1901 as a supplementary number of *Petermanns Mitteilungen*. From 1895 onwards he had worked energetically on the great "Geschichtlichen Atlas der Oesterreichischen Alpenländer," undertaken by the Vienna Academy of Sciences at his instigation. He unfortunately did not live long enough to see the first instalment of this work in print, though the manuscript was practically ready at the time of his death.

The Rev. S. L. Graham Sandberg.

Mr. Graham Sandberg, whose death on March 2 we regret to record, was a well-known authority on Tibetan questions, with which his knowledge of the Tibetan language made him exceptionally competent to deal. Only in 1902 he had acted as joint editor of the great Tibetan-English Dictionary compiled by Sarat Chandra Das for the Indian Government, and still more recently he had brought out a useful summary of the history of Tibetan exploration, in which he always took a great interest. Before the late expedition to Lhasa was decided on, he had given much care to the collection of information as to routes to that city, publishing the results in 1901. Mr. Sandberg was a senior chaplain on the Bengal establishment.

CORRESPONDENCE.

Protection from Snow-glare.

In Dr. Hunter Workman's interesting paper published in the March number of the *Geographical Journal*, he speaks of various devices for mitigating the effects of reflected heat from snowfields on the skin. It may interest him to hear that I have tried a mask made of yellow muslin for the purpose, and found it worse than useless.

The people of Chitral and Washigam, when taking their women on a journey, cover their faces with a preparation of clarified butter and burnt horn, with the idea of preserving their complexions, and they say it is very effective. Another alleged reason for this practice is, that it was originated by an edict made by a former *Mehtar*, in consequence of the loose state of the morals of the country, the motive being that women would thereby be rendered the reverse of attractive when they went in public.

As the faces of little children are also anointed in the same way when exposed to the sun, it seems likely that the first reason given is the true one.

R. L. Kennion, Major.

Bournemouth, March 11, 1905.

Botany of Grinnell Land.

Carrablagh, Portsalon, Co. Donegal.

I have just finished reading Otto Sverdrup's 'New Land.' I find on page 470, vol. 2, mention of my name ("the aforesaid Mr. Hart") in connection with botanical collections in the neighbourhood of Hayes sound (Grinnell Land) in 1875. He says, "From his list must therefore be excluded" (naming five or six species), several plants which he, Herman G. Simons, did not observe. It is a very unsafe thing to exclude plants from a previous observer's list because one fails to find them. Two at least of those he mentions are the same as he records under more recent nomenclature (the Arctic poppy, and one of the most disputed Drabas). Under the same category may be placed a third, *Cerastium latifolium*. Another is *Pedicularis flammea*, in which there is no mistake; but these species of semi-parasitic plants are most uncertain in their appearances. *Carex rigida* is assuredly correct—a very familiar species to me. And my *Potentilla anserina* was *not* recorded by me from the district he speaks of (not north of Cape Sabine). There remains only *Pedicularis lapponica*, which, as being a critical and interesting plant, I selected for further inquiry. I wrote to Kew, where my collections are chiefly to be found, at the Herbarium. Mr. Hemsley courteously replied that specimens of *Pedicularis lapponica*, from Dobbins bay, are amongst my collections in that repository. I have no time to pursue the subject further, nor do I feel justified in wasting that (more precious still) of the keepers of Kew and other Herbaria by further inquiries.

H. C. Hart.

P.S.—I do not think any other portions of this most interesting record of travels and endurance call for remark at my hand, but it is a blot on its pages to find the familiar musk-ox given a new, unsuitable, and evanescent name.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1904-1905.

Seventh Meeting, February 27, 1905.—Sir Clements Markham, K.C.B., President, in the Chair.

Elections.—*Gabriel Aarons; Captain Jas. Alex. Stewart Balmain* (15*th King's Hussars*); *Major A. P. Blenkinsop, R.A.M.C.; John Henry Close; Lieut. Hector James Doveton, I.A.; Prof. Chas. Redway Dryer, M.A., M.D.; Walter Douglas Elwin; F. W. English; Rev. John Heilley; Major M. L. Hornby, D.S.O.; Captain C. A. M. Howard; D. H. Langlands; John Theobald Leonard; William James Myatt; A. H. Glendower Newcomen; Captain A. H. Ollivant, R.G.A.; John T.*

Petro; Captain C. MacI. Ritchie, R.A.; Lieut. John Maitland Salmond (Lancaster Regt.); Hans Sauer; Robert Scott; Major-General E. J. E. Swayne, C.B.; Captain F. G. Turner, R.E.; Brevet-Major Geo. Greville Woods, R.A.

THE ANTARCTIC MEDAL.

The PRESIDENT: Before asking Captain Scott to read his paper, it will be my pleasure to deliver to him the special Gold Medal which has been struck in his honour by the order of the Council, for it was only a dummy that we were able to give him at the reception at the Albert Hall. The real medal is now finished, and it is presented to him by the Council as mementos of their appreciation, their high appreciation, of the admirable way in which he conducted the expedition from start to finish, and of the appreciation we have of the valuable results of that expedition. I now place the Gold Medal in Captain Scott's hands.

The Council also resolved to present silver replicas of Captain Scott's medal to the officers and men of the *Discovery*. They will be mementos to them of their commander, to whom they were all deeply attached, and also of their own admirable work. I propose to deliver them to those who are present, and the others will be sent.

The President then presented the medals to the various officers.

Captain SCOTT: I must first of all thank you, sir, for the gift of the medal to-night. I hope, sir, that though the medal you gave us before was a dummy, you will appreciate that our thanks given at that time were not dummies, and that we fully appreciated the great honour that we had received from this Society. I am sorry that so few members of the expedition are here to-night. It is with regret that we find ourselves scattered after having been so long together, and it is especially grievous that we cannot foregather on such a night as this, that all, like myself, might have received this highly valued reward directly from your hands.

The Paper read was:—

"The Scientific Results of the National Antarctic Expedition." By Captain R. F. Scott, C.V.O., R.N.

Eighth (Extra) Meeting, March 10, 1905.—Sir CLEMENTS MARKHAM, K.C.B., President, in the Chair.

As a considerable number of the Fellows were unable to obtain admission to the meeting on February 13, Sir Frank Younghusband kindly repeated his lecture on "The Geographical Results of the Tibet Mission."

Ninth Meeting, March 13, 1905.—Sir CLEMENTS MARKHAM, K.C.B., President, in the Chair.

ELECTIONS.—*Charles Francis Stanhope Bilbrough; S. Dickson Brown, M.A.; Lieut. J. Charteris, R.E.; Miles Wilfred Duffill; Francis Edwards; Arthur Fleet; Frederick Wm. Grantham; Christopher Richard Kempster, M.R.C.S., L.R.C.P.; Major R. J. Marker, Coldstream Guards, D.S.O.; George Frederick Stock; George Henry Vine; Sir James Lewis Walker, C.I.E.*

HONORARY CORRESPONDING MEMBER.

His Excellency Dr. Joachim Nabuco, Brazilian Minister.

The paper read was:—

"The Anglo-German Boundary Expedition in Nigeria." By Colonel Louis Jackson, R.E.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C. R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k. u. k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological, etc.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps—Glaciers. *C. Rd.* 139 (1904): 1049–1051. **Jacob and Flusin.**

La crue glaciaire de la fin du XIX^e^ siècle et les différents facteurs qui ont déterminé les anomalies de cette crue dans le massif du Pelvoux. Note de C. Jacob et G. Flusin.

Balkan Peninsula. **Meyer.**

Meyers Reisebücher. Türkei, Rumänien, Serbien, Bulgarien. Sechste Auflage. Leipzig und Wien: Bibliographisches Institut, 1902. Size 6½ × 4¼, pp. xii. and 384. *Maps, Plans, and Illustrations. Price* 7.50*m.*

Denmark. **Löffler.**

Dänemarks Natur und Volk. Eine geographische Monographie. Von Dr. E. Löffler. Kopenhagen: Lehmann & Stages Verlag, 1905. Size 9 × 6½, pp. 118. *Maps and Illustrations. Presented by the Author.*

A good general picture of Denmark, the Færoes, and Iceland.

Scandinavia. **Bain.**

Scandinavia, a Political History of Denmark, Norway, and Sweden from 1513 to 1900. By R. N. Bain. Cambridge: The University Press, 1905. Size 8 × 5¼, pp. viii. and 460. *Maps. Price 7s. 6d. Presented by the Publishers.*

The author holds that "the political history of Scandinavia is the history of the frustration of a great Baltic Empire." The main object which he has set before him is "to describe the rise of the Scandinavian kingdoms to political eminence, and their corresponding influence on European politics generally." There are maps illustrating political boundaries at various dates, and the gradual encroachment of Russia on Sweden.

United Kingdom—Worcestershire. **Duignan.**

Worcestershire Place-names. By W. H. Duignan. London: H. Frowde, 1905. Size 8 × 5, pp. x. and 186. *Price 6s. net. Presented by the Publisher.*

A careful investigation of the origin and history of the older place-names of Worcestershire, after the model of the same author's 'Staffordshire Place-names,' published in 1902. Books of the kind, of which several have appeared within the past few years, will materially help towards the eventual treatment of the whole

subject of British place-names, for a comprehensive work on which there is certainly room.

ASIA.

Asia. **Sievers.**

Asien. Von Prof. Dr. Wilhelm Sievers. (Allgemeine Länderkunde . . . herausgegeben von Prof. Dr. W. Sievers. Zweite . . . Auflage.) Leipzig und Wien: Bibliographisches Institut, 1904. Size 10 × 7, pp. xi. and 712. *Maps, Plates, etc. Price* 17*m.*

Like other volumes of the series, this has been thoroughly recast and revised in the second edition. It supplies, perhaps, the most accurate general account of Asia within the compass of a single volume that has been published.

Asia. **Tenney.**

Geography of Asia. By C. D. Tenney, LL.D. London: Macmillan & Co., 1904. Size 11½ × 9, pp. 76. *Maps. Price* 2 *dollars. Presented by the Publishers.*

The author is president of the Imperial Tientsin University, and has prepared this book for the use of English-speaking Chinese students. It shows few traces of the influence of modern conceptions as to the scope and function of geography, and is far too much a catalogue of facts without due correlation.

Asia—Meteorology. *Meteorolog. Z.* **21** (1904): 502–510. **Woeikof.**

Das sommerliche asiatische Luftdruck-Minimum. Von A. Woeikof.

Central Asia. *B.S.G. Italiana* **5** (1904): 451–490, 574–603, 633–671. **Brocherel.**

In Asia Centrale. Una esplorazione nel Tien Scian Centrale (Spedizione del principe don S. Borghese nel 1900). Per il Prof. G. Brocherel. *With Illustrations.*

Central Asia. *Ymer* **24** (1904): 237–258. **Hedin.**

De vetenskapliga resultaten af min sista resa. Af Sven Hedin. *Maps.*

China. **Hosie.**

China. No. 5 (1904). Report by Consul-General Hosie on the Province of Ssŭch'uan. London: Eyre & Spottiswoode, 1904. Size 13½ × 8½, pp. 102. *Maps. Price* 1*s.* 10*d.*

China—Hainan. *Rev. Française* **29** (1904): 649–656. **Servigny.**

Hainan et son Commerce. Par J. Servigny.

Japan. **Rein.**

Japan, nach Reisen und Studien im Auftrage der Königlich Preussischen Regierung dargestellt von J. J. Rein. Erster Band. Natur und Volk des Mikadoreiches, Zweite Auflage. Leipzig: W. Engelmann, 1905. Size 10 × 6½, pp. xiv. and 750. *Maps, Plans, and Illustrations. Presented by the Author.*

This has been thoroughly revised, and embodies the results of recent Japanese research in geology and other branches of science.

Turkey. **Azoury.**

Le Réveil de la Nation Arabe dans l'Asie Turque. . . . Par Negib Azoury. Paris: Plon-Nourrit et Cie., [1905]. Size 7½ × 5, pp. 258. *Portrait. Price* 3.50*fr. Presented by the Author.*

Traces the recent development of a national Arabian party, and discusses its probable influence on the political, religious, and economic future of the near East. The writer points out that it is only by the help of Arabian soldiers that the other populations subject to the Turks are kept in check, and thus shows the immense importance for the Eastern question of the possible rise of an independent Arab power.

Turkey—Arabia. **Hadji Khan and Sparroy.**

With the Pilgrims to Mecca. The Great Pilgrimage of A.H. 1319; A.D. 1902. By Hadji Khan and W. Sparroy. With an Introduction by Prof. A. Vambéry. London and New York: J. Lane, 1905. Size 9 × 6, pp. 314. *Illustrations. Price* 12*s.* 6*d. net. Presented by the Publisher.*

This book includes the substance of a series of articles published in the *Morning Post*, but contains in addition much new matter. Prof. Vambéry considers that it supplies the need, that has hitherto existed, "of an account of the Haj, written by a Mohammedan who is not attracted by curiosity, but by religious piety, who had free access to every place, who is not hampered by fear of being discovered as a Christian, and who is, besides, a shrewd observer." The first-named author, though a Musulman, has had a thorough English education.

AFRICA.

Algeria. *C. Rd.* **139** (1904): 1235–1237. **Lamothe**

Les anciennes lignes de rivage du Sahel d'Alger. Note de M. le Général de Lamothe.

This has been referred to elsewhere (*ante*, p. 214).

Algeria. *Rev. G.* **28** (1904): 339–349. **Normand.**

L'Extrême-Sud Oranais (Etude de Géographie militaire). Par Capitaine R. Normand. *Map and Illustrations.*

British Central Africa—Meteorology. ———

British Central Africa Protectorate. Results of Nyasaland Meteorological Observations for the year 1904. Prepared by the Scientific Department, Zomba. Size 13½ × 8½.

British East Africa. ———

Africa. No. 15 (1904). Report on the East Africa Protectorate for the year 1903–4. London: Wyman & Sons, 1905. Size 13½ × 8½, pp. 50. *Price* 5½*d.*

British East Africa. **Eliot.**

The East Africa Protectorate. By Sir C. Eliot, K.C.M.G. London: E. Arnold, 1905. Size 9 × 6, pp. xii. and 334. *Maps and Illustrations. Price* 15*s. net. Presented by the Publisher.* [To be reviewed.]

British East Africa and Uganda. **Powell-Cotton.**

In Unknown Africa: a Narrative of Twenty Months' Travel and Sport in Unknown Lands and among New Tribes. By Major P. H. G. Powell-Cotton. London: Hurst & Blackett, 1904. Size 9 × 6, pp. xxiv. and 620. *Maps and Illustrations. Price* 21*s. Presented by the Publishers.* [To be reviewed.]

East Africa. **Schillings.**

Mit Blitzlicht und Büchse. Neue Beobachtungen und Erlebnisse in der Wildnis inmitten der Tierwelt von Aequatorial-Ostafrika. Von C. G. Schillings. Zweiter Abdruck. Leipzig: R. Voigtländer, 1905. Size 10 × 7, pp. xvi. and 558. *Illustrations. Price* 14*m. Presented by the Publisher.*

Contains a most striking series of photographs of living animals of every kind, taken in their natural surroundings. Some were taken by night by the aid of the flashlight, and include several examples of lions in the act of springing on their prey.

Egypt. **Steindorff.**

Durch die Libysche Wüste zur Amonsoase. Von G. Steindorff. (Land und Leute, herausgegeben von A. Scobel. XIX.) Bielefeld und Leipzig: Velhagen & Klasing, 1904. Size 10½ × 7, pp. 164. *Map and Illustrations. Price* 4*m.*

Egypt—Suez Canal. **Ungard.**

Der Suezkanal, seine Geschichte, seine Bau- und Verkehrsverhältnisse und seine militärische Bedeutung. Von Albert Ungard Edler von Öthalom. Wien und Leipzig. A. Hartleben, 1905. Size 9½ × 6½, pp. viii. and 104. *Maps and Profile. Price* 4*s.*

Eritrea. **Perini.**

Magg. R. Perini (Gabrè-Negùs). Di qua dal Marèb (Marèb-mellàsc'). Firenze: Tip. Cooperativa, 1905. Size 10 × 7, pp. 464. *Maps. Presented by the Author.*

A detailed study (intended to supplement the account of Werner Munzinger) of the portion of Eritrea immediately to the north of the Mareb, where the author was stationed for some years. There is also an introductory chapter dealing in a general way with the characteristics of this part of Africa. A good map is given, on the scale of 1 : 500,000, as well as a facsimile of the map (itself mainly based on that of Ludolf) given with Legrand's edition of Lobo.

Rhodesia. **Hall.**

Great Zimbabwe, Mashonaland, Rhodesia. An account of Two Years' Examination Work in 1902–4 on behalf of the Government of Rhodesia. By R. N. Hall. With an Introduction by Prof. A. H. Keane, LL.D. London: Methuen & Co., [1905.] Size 9 × 6, pp. xliv. and 460. *Map, Plans, and Illustrations. Price* 21*s. net. Presented by the Publishers.* [To be reviewed.]

Tunis and Algeria. **Loth.**

Le peuplement Italien en Tunisie et en Algérie. Par G. Loth. Paris: A. Colin, 1905. Size 10½ × 6½, pp. 502. *Maps and Illustrations. Price* 10 *fr. Presented by the Publisher.*

An inquiry into the causes and probable results of the constantly increasing

Italian immigration into Algeria and Tunis, which the author considers as not dangerous to France.

NORTH AMERICA.

Canada. **Johnson.**

Louisiana Purchase Exposition, 1904. Canada: its History, Productions and Natural Resources. Prepared by G. Johnson, D.C.L. Ottawa: Department of Agriculture of Canada, 1904. Size 9 × 6, pp. 176. *Maps and Illustrations.*

Canada. *Appalachia* **10** (1904): 373-383. **Tewes.**

In the Southern Waputehks. Mount Daly—Takakkaw Glacier and Fall—Lower Yoho Canyon. By E. Tewes. *Illustr.*

North America. **Deckert.**

Nordamerika. Von Dr. Emil Deckert. (Allgemeine Länderkunde . . . herausgegeben von Prof. Dr. Wilhelm Sievers. Zweite . . . Auflage.) Leipzig und Wien: Bibliographisches Institut. 1904. Size 10 × 7, pp. xii. and 608. *Maps, Plates, etc. Price* 16*m.*

During the interval which has elapsed since the publication of the first edition, the author has added extensively to his personal knowledge of North America, and has likewise fully availed himself of the abundant material supplied by the various Government departments in the United States and Canada, as well as other sources of knowledge. The value of the work has thus been greatly enhanced.

United States—Maryland. ———

Maryland Geological Survey, Miocene. Text and Plates. Baltimore, 1904. Size 10½ × 7, pp. clvi. and 544. *Maps and Plates. Presented by the Maryland Geological Survey.*

POLAR REGIONS.

Antarctic—Belgian Expedition. ———

The Belgian Antarctic Expedition, under the command of A. de Gerlache de Gomery. Summary Report of the Voyage of the *Belgica* in 1897-1898-1899. Brussels, 1904. Size 11 × 7, pp. 70. *Maps and Illustration.*

Apparently a translation of one of the parts of the 'Résultats du Voyage du S.Y. *Belgica*,' still in course of publication.

Antarctic—Swedish Expedition. **Nordenskjöld and Andersson.**

Antarctica; or, Two Years amongst the Ice of the South Pole. By Dr. N. Otto G. Nordenskjöld and Dr. J. G. Andersson. London: Hurst & Blackett, 1905. Size 9½ × 6½, pp. xviii. and 608. *Maps and Illustrations. Price* 18*s. net. Presented by the Publishers.* [To be reviewed.]

Spitzbergen—Historical. **Conway.**

Early Dutch and English Voyages to Spitzbergen in the Seventeenth Century, including Hessel Gerritsz.: 'Histoire du pays nommé Spitsberghe,' 1613, translated into English, for the first time, by Basil H. Soulsby, of the British Museum; and Jacob Segersz. van der Brugge: 'Journael of Dagh Register,' Amsterdam, 1634; translated into English, for the first time, by J. A. J. de Villiers, of the British Museum, etc. Edited, with Introductions and Notes, by Sir W. Martin Conway. London: Printed for the Hakluyt Society, 1904. Size 9 × 6, pp. xvi. and 192. *Maps. Presented by the Hakluyt Society.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geology. **Branner and Newsom.**

Syllabus of a Course of Lectures on Economic Geology. By J. C. Branner, PH.D., and J. F. Newsom. Second Edition. Stanford University, 1900. Size 9½ × 6, pp. 368. *Diagrams and Sections. Presented by Dr. J. C. Branner.*

Geology. **Merrill.**

A Treatise on Rocks, Rock-weathering and Soils. By G. P. Merrill. New York: the Macmillan Company, 1904. Size 9 × 6, pp. xx. and 412. *Illustrations. Price* 17*s. net. Presented by the Publishers.*

Brings together the results of several years' study of the phenomena attendant upon rock degeneration and soil formation, which, the author thinks, have been somewhat neglected, in the attention given to the structure and origin of rocks. The subject is a branch of geology possessing a special interest to the physical geographer.

Glacial Epoch. *G.Z.* **10** (1904): 593–600. **Meyer.**

Die Eiszeit in den Tropen. Von Prof. Dr. H. Meyer.

Noticed in the Monthly Record for March, p. 333.

Landscape. **Geikie.**

Landscape in History, and other Essays. By Sir A. Geikie. London: Macmillan & Co., 1905. Size 9½ × 6, pp. viii. and 352. *Price* 8*s.* 6*d. net. Presented by the Publishers.*

A collection of essays and addresses on various subjects connected with Physical Geography and allied sciences, presenting the same charm of thought and diction which characterize the author's previous writings. The first three deal with Landscape in its relations to History, the Imagination and Literature. Others deal with the origin of the Scenery of Britain, the Huttonian Theory, Geological time, etc.

Magnetic Declination. *Deutsch. G. Blätter* **27** (1904): 158–175. **Wolkenhauer.**

War die magnetische Deklination vor Kolumbus erster Reise nach Amerika tatsächlich unbekannt? Von Dr. A. Wolkenhauer.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Anthropogeography—Man and Weather. **Dexter.**

Weather Influences. An Empirical Study of the Mental and Physiological effects of definite Meteorological Conditions. By E. G. Dexter, PH.D. With Introduction by Cleveland Abbe, LL.D. New York: the Macmillan Co.; London: Macmillan & Co. 1904. Size 9 × 6, pp. xxxii. and 286. *Diagrams. Presented by the Publishers.*

Historical—Early Travels. **Purchas.**

Hakluytus Posthumus or Purchas His Pilgrimes Contayning a History of the World in Sea Voyages and Lande Travells by Englishmen and others. By Samuel Purchas, B.D. Vols. i. and ii. Glasgow: J. MacLehose & Sons, 1905. Size 9 × 6, pp. (vol. i.) l. and 504; (vol. ii.) xvi. and 550. *Map and Portraits. Price* 12*s.* 6*d. net per volume. Presented by the Publishers.*

The first two volumes of a reprint of Purchas, produced in the same fine style as the same publishers' edition of Hakluyt. It is not quite easy to see the motive for issuing the two series in precisely the same binding, a practice which, in the eyes of many, swamps the individuality of the separate works, but it is probably a concession to popular taste. All the original maps and plates will be reproduced, though, curiously enough, there is nothing to show the unlearned (in the case of most of the plates) that they are taken from Purchas.

BIOGRAPHY.

Biographical Dictionary. **Poggendorff.**

Biographisch-Literarisches Handwörterbuch zur Geschichte der Exacten Wissenschaften . . . gesammelt von J. C. Poggendorff. 4 vols. (Dritter Band (1858 bis 1883), herausgegeben von Dr. B. W. Feddersen und Prof. Dr. A. J. von Oettingen.) Leipzig: J. A. Barth, 1863–1904. Size 10 × 6½, pp. (vol. i.) viii. and 1584 cols.: (vol. ii.) 1468 cols.; (vol. iii.) viii. and 1496 pp.; (vol. iv.) xii. and 1718 pp.

This invaluable work of reference has, after an interval of twenty years, been once more brought up to date by the issue of a fourth volume comprising the period 1883–1904. Although here and there omissions are noticeable, the laborious work of compilation seems on the whole to have been carried out with great thoroughness. The space devoted to the last twenty years is, of course, relatively far greater than ever before.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

British Isles. **Scarborough.**

Scarborough's Map of England and Wales, showing Geographical Counties and Boroughs, all Railways and Steamship Lines, with Distances between Stations and Landings. Scale 1 : 633,600 or 10 stat. miles to an inch. *Price* 12*s.*, *mounted on rollers and varnished.*—Scarborough's Map of Scotland, showing Counties, all Railways and Steamship Lines, with Distances between Stations and Landings. Scale 1 : 443,520 or 7 stat. miles to an inch. *Price* 15*s.*, *mounted on rollers and*

varnished. Boston and London: The Scarborough Company. *Presented by the Publisher.*

The Scarborough Company are issuing maps of European countries upon the same lines and in the same style as their American series. The two mentioned above, if not artistic productions, will certainly be useful to commercial men and travellers. Railways seem to have received special attention, as is the case with the American series. No serious attempt has been made to show hill features, although isolated hills are indicated here and there. A table of distances and an index to places is given on each map. The maps are varnished and mounted on rollers.

Crete. **Mpikaki.**

Map of Crete. By A. I. Mpikaki. Scale 1 : 300,000 or 4·7 stat. miles to an inch. Athens; D. K. Kokkinakis, 1905. [In Greek.]

A roughly executed general map of the island, with ancient sites in red.

England. **Bartholomew.**

Bartholomew's New Reduced Survey of England and Wales. Scale 1 : 126,720 or 2 stat. miles to an inch. Aldershot District. Edinburgh: John Bartholomew & Co., [1905]. *Price 2s. net. Presented by the Publishers.*

England and Wales. **Ordnance Survey.**

Ordnance Survey of England and Wales:—Sheets published by the Director-General of the Ordnance Survey, Southampton, from February 1 to 28, 1905.

6-inch—County Maps (first revision):—

Brecknockshire, 8 N.E. **Cambridgeshire,** 1 S.W., S.E., 3 N.E., S.E. **Gloucestershire,** 11 N.E. **Herefordshire,** 5 S.E., 10 N.W., 20 N.W., 24 S.W., 26 N.W., 27 N.E., S.W., 28 N.W., 31 N.E., S.E., 32 N.W., N.E., 33 N.W., S.W., 34 S.W., 47 S.E., 52 N.W., N.E., 54 N.W. **Leicestershire,** 3 N.W., S.W., 8 S.W., 14 N.E., 18 N.W., 47 S.W. **Lincolnshire,** 113 N.W., S.W., 122 S.W., 130 N.E., 139 S.W., S.E., 146 S.W., 150 N.E., S.E. **Radnorshire,** 17 S.W., S.E., 18 N.W., S.E., 24 N.W., S.W., 25 N.W., 27 N.E., 28 S.W., S.E., 32 N.E., 33 N.W., 34 S.W. **Rutland,** 3 S.W., S.E., 7 S.W., 9 S.E., 10 N.W., N.E., S.E., 14 N.E., S.W., 15 N.E., S.W. **Somerset,** (7 N.W. and S.W.), 50 S.W., 60 S.E., 70 N.W., N.E., 79 N.E., S.E. **Staffordshire,** 69 S.W., 72 N.E., S.E. **Suffolk,** 80 N.W. **Warwickshire,** 8 S.W., 9 S.E., 13 N.E., S.E., 16 N.E. **Worcestershire,** 5 N.E., S.E., 16 S.W., 27 S.E., 28 S.E., 54 N.E. **Yorkshire** (first revision of 1891 Survey), 287 N.E. *1s. each.*

25-inch—County Maps (first revision):—

Brecknockshire, I. 16; IV. 3, 4, 6, 7, 8, 10, 11; VII. 4, 10, 13, 14, 15, 16; VIII. 2, 6, 9, 10, 13, 14; X. 2, 3, 4; XI. 1, 2; XX. 1. **Cardiganshire,** II. 9, 10, 13, 14; III. 2, 3, 7, 10, 11, 16; IV. 1, 2, 5, 6, 9, 10, 11, 12, 15; VII. 1, 2, 3, 4, 5, 6, 7, 11. **Carmarthenshire,** XIX. 1. **Devonshire,** IVa. 2, 10, 14; XVIII. 14; XXVIII. 2, 3, 4, 12; XXIX. 1, 5; XXXI. 1, 3, 4, 5, 6, 7, 9, 10, 11, 12; XLIV. 14, 16; XLV. 3, 7, 9, 13, 14, 15, 16; LV. 2, 7, 10, 11, 15; LVI. 6, 11, 13; LVII. 1, 9; LXVIII. 9; LXIX. 8, 12, 13, 15, 16; LXX. 10; LXXXI. 12, 14, 15; LXXXII. 1, 5, 13; XCIII. 2, 6, 8, 10, 12; XCIV. 5, 13; **Herefordshire,** VIII. 15; XIII. 2, 3, 8, 10 (11 and 7), 12; XIV. 5, 6, 7; XXI. 8. **Lincolnshire,** CIV. 1, 2, 3, 4, 6, 7, 8, 11, 12, 13, 15; CXV. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16; CXVI. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15; CXVII. 1, 2, 3, 4, 5, 7, 9, 10, 11, 13, 14, 15; CXXVIII. 5, 6, 9, 10, 11, 13, 14, 15. **Norfolk,** XCI. 7; XCII. 5, 6, 7, 8, 9, 11, 12, 13, 15, 16; XCIII. 5, 6, 12, 14, 15, 16; CII. 4, 7; CIII. 15; CIV. 6, 10, 11, 14, 16; CV. 9, 10, 14; CVI. 5, 9; CIX. 1, 4; CX. 1, 3, 4, 6. **Radnorshire,** XIV. 1, 4, 8, 11, 12, 14, 15, 16; XXI. 3, 4, 6, 7, 10, 11. **Suffolk,** VI. 13, 15, 16; VII. 14, 15; XII. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16; XIV. 15; XXIV. 1, 4; XXV. 1, 6; XXXI. 3, 4. **Warwickshire,** XIV. 2, 6; XXI. 13, 14; XXII. 12; XXIII. 10, 15; XXV. 1, 4, 5, 6, 8, 10, 11, 12; XXVI. 1, 2, 3, 5, 6, 7, 9, 11; XXXI. 2, 5; XLIII. 13; XLIX. 1, 2. **Worcestershire,** XVIII. 12, 16; XIX. 9, 13; XXIV. 2, 5; XXV. 4, 8; XXVI. 6, 7, 8; XXXVI. 13; XXXIX. 12; XLIII. 1, 2. **Yorkshire** (first revision of 1891 Survey), CCLXXXVIII. 6, 10. *3s. each.*

England and Wales. **Geological Survey.**

1-inch map (New Series). Colour printed.

Bournemouth, 329; Swanage, 343; Drift editions. *1s. 6d. each.* (*E. Stanford, London Agent.*)

Europe. **Bartholomew.**

Bartholomew's Railway and Steamship Map of Europe and the Mediterranean. From latest surveys. By J. G. Bartholomew, F.R.S.E. Scale 1 : 5,448,960 or 86 stat. miles to an inch. Edinburgh: John Bartholomew & Co., [1905]. *Price 2s. net. Presented by the Publisher.*

Finland. **Inberg.**

Karta öfver Storfurstendömet Finland. Af I. J. Inberg. Scale 1 : 1,000,000 or 15·8 stat. miles to an inch. 4 sheets. Helsingfors: F. Tilgmann.

This map has evidently been reduced by photography from drawings on a larger scale, with the result that the lettering is so small in places as to be almost illegible without a glass. However, it is a good, useful map for general reference, containing a great deal of information. It is printed in colours. A useful table of distances between places in Finland is given as an inset.

France. **Lang.**

Schulwandkarte des Kriegsschauplatzes 1870–71 und der wesentlichen kriegerischen Begebenheiten. Scale 1 : 350,000 or 5·5 stat. miles to an inch. Third edition. 4 sheets. Leipzig: George Lang.

Ireland. **Bartholomew.**

Bartholomew's "Quarter-inch to Mile" Map of Ireland. Reduced by permission from the Ordnance Survey. Sheets: 1, Donegal and Enniskillen; 3, Connemara and Sligo. Edinburgh: John Bartholomew & Co., [1905]. *Price 2s. net each sheet. Presented by the Publishers.*

With the publication of these two sheets Bartholomew's "Quarter-inch to Mile" map of Ireland is complete. There are altogether seven sheets, of which the first to be issued was noticed in the *Geographical Journal* for June last. In general appearance the sheets resemble the well-known maps of England and Scotland, which have deservedly gained a wide reputation amongst tourists and others, except that some of the tints employed in the orographic shading have been improved from an artistic point of view, especially the greens.

Vistula. **Petermanns Geographische Mitteilungen.**

Die Veränderung im Mündungsgebiet der alten Danziger Weichsel in den letzten drei Jahrhunderten. Reduziert nach der Karte der Königl. Preussischen Geologischen Landesanstalt 1903. Scale 1 : 30,000 or 2·1 inches to a mile. *Petermanns Geographische Mitteilungen*, Jahrgang 1905, Tafel 4. Gotha: Justus Perthes, 1905. *Presented by the Publisher.*

ASIA.

Asia. **Military Topographical Dept., St. Petersburg.**

Map of the Southern Frontier Regions of Asiatic Russia. Scale 1 : 1,168,031 or 18·4 stat. miles to an inch. Sheet VIII. bis, Nikolaievsk. St. Petersburg: Military Topographical Department, 1903. [In Russian.]

This sheet includes the mouth of the Amur and the northern part of the island of Sakhalin.

Asia Minor. **Kiepert.**

Karte von Kleinasien. Von Dr. Richard Kiepert. Scale 1 : 400,000 or 6·3 stat. miles to an inch. Sheet D ii. Adalia. Berlin: Dietrich Reimer (Ernst Vohsen), 1905. *Price 6m.*

The eastern and southern sheets of this map are now published, and all that remains of the twenty-four sheets comprising the complete map are the eight western sheets. Since the publication of the eastern sheets a considerable amount of additional cartographical information has been obtained, which will render revision of this part most desirable.

Manchuria. **Topographical Section, General Staff.**

Map of Country round Mukden to illustrate the Campaign in Manchuria. Reproduced from the Russian Staff Map, 1904. Scale 1 : 420,000 or 6·6 stat. miles to an inch. London: Topographical Section, General Staff, War Office, 1905. *Price 2s.*

AMERICA.

Canada—Ontario. **Scarborough.**

Scarborough's Map of Ontario, with an Index of all Cities, Villages, Post Offices, and Railway Stations, and population according to the 1901 Census. Based upon the latest Government Surveys and Explorations. Scale 1 : 950,400 or 15 stat. miles to an inch. Boston and London: The Scarborough Company. *Presented by the Publishers.*

A useful map containing much information. One of the important features is the numerous notes upon the map concerning the character of the country, giving particulars of physical features, forests, and land suitable for agriculture. There is a useful index, and a table of distances between all important places. The map is mounted on rollers.

United States. **Scarborough.**

Scarborough's Map of California. Scale 1 : 887,040 or 14 stat. miles to an inch. Scarborough's Topographic Map of Massachusetts. Scale 1 : 205,920 or 3·2 stat. miles to an inch.—Scarborough's New Railroad, Post Office, Township and County Map of New York. Scale 1 : 475,200 or 7·5 stat. miles to an inch. Boston and London: The Scarborough Company. *Price* $5 *each, mounted on rollers and varnished. Presented by the Publishers.*

These form part of a series of useful commercial and general maps of the United States, which are now in course of publication by the Scarborough Company. The scale upon which they are drawn is sufficiently large to permit of a considerable amount of useful information being given, and great care has been taken to bring them up to date as far as possible. There are inset maps and plans of important centres, and upon each is a useful table of distances between places, and an excellent index. The maps are highly coloured and mounted on rollers. Hardly any attempt has been made to show relief, and the execution throughout is decidedly rough. Still, for commercial and travelling purposes the maps will doubtless be of service.

ATLANTIC OCEAN.

Atlantic Ocean. **Stanford.**

The Autograph Hand-maps: The Atlantic Ocean on Mollweide's Equal Area Projection. Oxford: William Stanford & Co. *Price* 1*d. net. Presented by the Publishers.*

An outline only of a diagrammatic character.

PACIFIC OCEAN.

Guam Island. **Petermanns Geographische Mitteilungen.**

Insel Guam (Marianen). Nach den amerikanischen Aufnahmen 1901–1902 reduziert nach der Karte des Hydrographischen Amts in Washington 1904. Scale 1 : 225,000 or 3·5 stat. miles to an inch. *Petermanns Geographische Mitteilungen,* Jahrgang 1905, Tafel 3. Gotha: Justus Perthes, 1905. *Presented by the Publishers.*

GENERAL.

World. **Philip.**

Philips' Elementary Atlases of Comparative Geography. Edited by George Philip, F.R.G.S. Birmingham and Midlands Edition. Northumberland Edition. London: George Philip & Son, Ltd. *Price* 1*s. net. each. Presented by the Publishers.*

In their main features and general maps these two school atlases are similar, the difference being that the "Northumberland edition" contains special maps of northern England and Northumberland, and a plan of the Tyneside ports; whilst the "Birmingham and the Midlands edition" gives special maps of Central England, the Midlands, the Birmingham District, and the Potteries. The arrangement of preparing separate editions for special localities has much to commend it from an educational point of view, and the atlases will doubtless find their way into many of the elementary schools of the respective districts for which they are intended, especially as they can be obtained for one shilling. The physical maps indicate the relief by orographical colouring in combination with hill shading, and if somewhat rough in appearance, the maps are clear and not overcrowded.

World. **Stieler.**

Neue, neunte Lieferungs-Ausgabe von Stielers Hand-Atlas. 100 Karten in Kupferstich herausgegeben von Justus Perthes Geographischer Anstalt in Gotha. 41 und 42 Lieferung. Gotha: Justus Perthes, [1905].

These two parts, which are in one cover, contain the following maps: No. 5, North Polar Regions, by H. Habenicht, scale 1 : 20,000,000; No. 6, South Polar Regions, by H. Habenicht, scale 1 : 40,000,000; Nos. 11 and 12, sheets 3 and 4 of a map of Germany, by C. Scherrer, scale 1 : 1,500,000.

CHARTS.

Chile. **Chilian Hydrographic Office.**

Chilian Hydrographic Chart, No. 100, Bahia Tongoi. Scale 1 : 50,000 or 1·3 inch to a stat. mile. Valparaiso: Oficina Hidrografica, Marine de Chile, 1904. *Presented by the Chilian Hydrographic Office.*

North Atlantic and Mediterranean. **Meteorological Office.**

Pilot Chart of the North Atlantic and Mediterranean for March, 1905. London: Meteorological Office, 1905. *Price* 6*d*. *Presented by the Meteorological Office.*

North Pacific. **U.S. Hydrographic Office.**

Pilot Chart of the North Pacific Ocean for March, 1905. Washington: United States Hydrographic Office, 1905. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

India. **Yate.**

Four photographs of an old Mahommedan Cemetery near Malir, 18 miles north-east of Karachi, India. Taken by Lieut.-Col. A. C. Yate. *Presented by Lieut.-Col. A. C. Yate.*

Colonel Yate, in a note forwarded with these photographs, states that this cemetery is about 150 years old, and is situated near the head of the Malir waterworks, which supply all Karachi with water. Nothing seems to be known definitely of its origin, but according to native tradition the tombs are those of Baluchis slain in battle. Colonel Yate is, however, inclined to believe that the central domed tomb is that of some holy man of Islam, around whose shrine the faithful have brought their dead for burial.

Kashmir and Tibet. **Charrington.**

Eighty photographs of Kashmir and North-West Tibet, taken by Lieut. S. H. Charrington, 15th Hussars. *Presented by Lieut. S. H. Charrington.*

An interesting series of small photographs taken on a journey from Leh through Baltistan to the frontier regions of Western Tibet during the summer of last year. The following are the titles:—

(1 and 2) The Sind river at Sonamarg; (3) View from Sonamarg; (4) Baggage ponies grazing at Sonamarg; (5) Leh from the south-east; (6) Main street, Leh; (7) Leh bazaar; (8) Loading up at Leh; (9) Marsimik La, Ladakh; (10) Tsokr Chumo lake; (11) Camp at Pomlung, Ladakh; (12) Chimray lamasery; (13 and 14) Chang La; (15) Crossing the Chang La; (16) Ladakhis from Tankse who accompanied the caravan; (17) Ladakhi women near Tankse; (18) Upshi village; (19) Gya village; (20) Strata between Gya and Miru; (21) Zoji La; (22) A "yakh" on the Shiok river; (23) Inflating a "yakh"; (24) Crossing the Shiok river on a "yakh"; (25) Tent at Tang, Shiok valley; (26) Shiok river above Tang; (27) Ibex ground, La-onchon, Shiok river; (28) View from the top of Waris pass, Shiok valley; (29) Nubra Rajah's palace, Charasa; (30) Nubra Rajah's palace from near Taggar; (31) Large "mani" rocks at Kubet; (32) Bridge over the Shiok river; (33) Kardong La from the north; (34) Descending north side of Kardong La; (35) Looking towards Leh from Kardong La; (36) Pamzal, Chang-Chenmo; (37) View east from Kiam, Chang-Chenmo; (38) Camp 4 miles east of Piwuk; (39) Pangong lake; (40) Camp, Garm-pani; (41) Base camp at Tab-mar-marvo; (42 and 43) Bukshen glaciers, from Tab-mar-marvo; (44 and 45) Panorama of Herpa Tso; (46) Camp south of Herpa Tso; (47) Yak ground south of Herpa Tso; (48) Camp 8 miles east of Herpa Tso; (49) View south from camp at Lanak; (50) Camp below Lanak La; (51) Tibet from the Lanak La; (52) Bharal; (53 and 54) *Ovis Hodgsoni*; (55 and 56) Goa; (57) Herd of wild yak; (58) Solitary bull yak; (59) Kyang; (60–62) Tibetan antelope; (63) Salt lake, No. 2; (64) Caravan returning from Tibet; (65) Kipalu, Baltistan; (66) Rajah of Kipalu's two brothers; (67) Poplar avenue at Kiris; (68) "Yakh" at Kipalu; (69) Prahnu, Baltistan; (70) Paxfain, Baltistan; (71) Nullah above Sermik, Baltistan; (72 and 73) Shiller pass on to the Deosai plain; (74 and 75) The Gilgit road; (76) Marpanon, on the Gilgit road; (77) Bridge No. 6, Srinagar; (78) Bridge No. 7, Srinagar; (79) Lamaryuru lamasery; (80) Tiksai lamasery.

Kordofan. **Lloyd.**

Fourteen photographs of Kordofan, taken by Captain W. Lloyd. *Presented by Captain W. Lloyd.*

Few photographs have been taken in Kordofan, consequently these form a welcome addition to the Map Room collection. They are principally types of natives:—

(1–3) Sheik Ismail Mohammed el Sheikh, Nazir of the Asakara section of the Hamar's; (4) Sheikh Mustafa abu Ranat; (5) Beshir bey Kambal, who was with Gordon as a young man; (6) Hamid bey Fatin, Nazir of the Hamar Degagin, was made a bey by Gordon; (7) Sheikh Ali, son of Hamid bey Fatin; (8) Sheikh Salem Bakhri; (9) Iron smelting at Nahud; (10) Egyptian Army transport; (11) Sheikh of Falata's as El Obeid; (12–14) Women of Northern Nigeria on their way to Mecca.

Pamirs. **Mackintosh.**

Ninety photographs of the Taghdumbash Pamir, and the road to it by Gilgit and Hunza. Taken by Captain J. B. Mackintosh, R.A. *Presented by Captain J. B. Mackintosh, R.A.*

These little photographs serve well to illustrate the physical characteristics of the Pamir region, and the route thither from Kashmir. The titles are as follows:—

(1) The Wular lake and valley of Kashmir; (2) Tragbal, near top of Rajdiangau pass; (3) Halfway down Rajdiangau pass, looking towards Gurais; (4) Near Gurais; (5) Gurais; (6) On the Burzil pass; (7) Astore; (8) Ruttu and Mir Malik nullah; (9) Polo in a dust-storm at Ruttu; (10) Rupple bridge and Nanga Parbat in clouds; (11 and 12) The Hatu Pir; (13) The Ramghat bridge; (14) Bunji, on the banks of the Indus; (15) Nanga Parbat from Bunji; (16) Gilgit; (17) Rakapushi; (18) Nilt in the Hunza valley; (19) Minapin, a village in the Hunza valley; (20) Rakapushi from near Baltit, Hunza; (21) Wazir Humayun of Hunza; (22) Humayun, his son, and the British political munshi at Baltit; (23) Coolies leaving Baltit, Hunza; (24) Village of Altit, Hunza valley; (25) Pasu river and end of glacier; (26) On the Batur glacier; (27) Path near Batur glacier; (28) Fort and village of Kaibar, Hunza valley; (29) Hunza river, north of Khaibar; (30) Rope bridge over the Chupersan river; (31–33) A bit of the path; (34) Misgar, the last village on the southern watershed of the Himalayas; (35) Rope bridge at Misgar; (36) Yaks with baggage entering Mispar on return journey; (37) Murkushi; (38) Bun-i-Kotal, looking south; (39) Bun-i-Kotal, looking west; (40) The Kilik pass in Chinese Territory; (41) The first camp on the Pamirs; (42) Riding yaks on side of a hill; (43) West end of Taghdumbash Pamirs; (44) Camp in Kukturruk nullah; (45) First *Ovis poli*, Kukturruk nullah; (46) The Wakhjir pass from Taghdumbash Pamirs; (47) Yaks with *Ovis poli* heads; (48) Khor Kosh Beg, with his wives and family; (49) An encampment of shepherds; (50) Camp in the Khunjerab valley at entrance to Ophrang pass; (51) East end of Ophrang pass; (52) Entrance to Orphrang pass; (53) Head of *Ovis poli*; (54 and 55) Khunjerab pass; (56) General view of Tashkurgan; (57) Russian fort, Tashkurgan; (58–60) Panorama of Tashkurgan; (61) Sher Mahomed; (62) Amban of Sarikol; (63) Captain J. B. Mackintosh, Amban, and Amban's followers; (64) Amban and tumchis; (65) Group of Sarikoli horsemen; (66) Amban and retinue; (67) The Bejik pass; (68) Head of Bejik nullah; (69) Heads of *Ovis poli*; (70) Taghdumbash Pamir; (71) A side valley near Mintaka; (72) Karachnai pass; (73) The top of Karachnai pass; (74) The view from top of Karachnai pass; (75) Entrance to Mintaka pass from Chinese side; (76 and 77) Mintaka pass; (79 End of Kirish glacier and mouth of Mintaka pass; (80) Kirish glacier; (81) On the road to Murkushi; (82) Where the road bifurcates at Murkushi; (83) Shikari; (84) The Jhelum at Srinagar; (85) A canal at Srinagar; (86) On the Dal lake, Srinagar; (87) Gulmarg, the western Marg; (88 and 90) View of Gulmarg; (89) Golf links, Gulmarg.

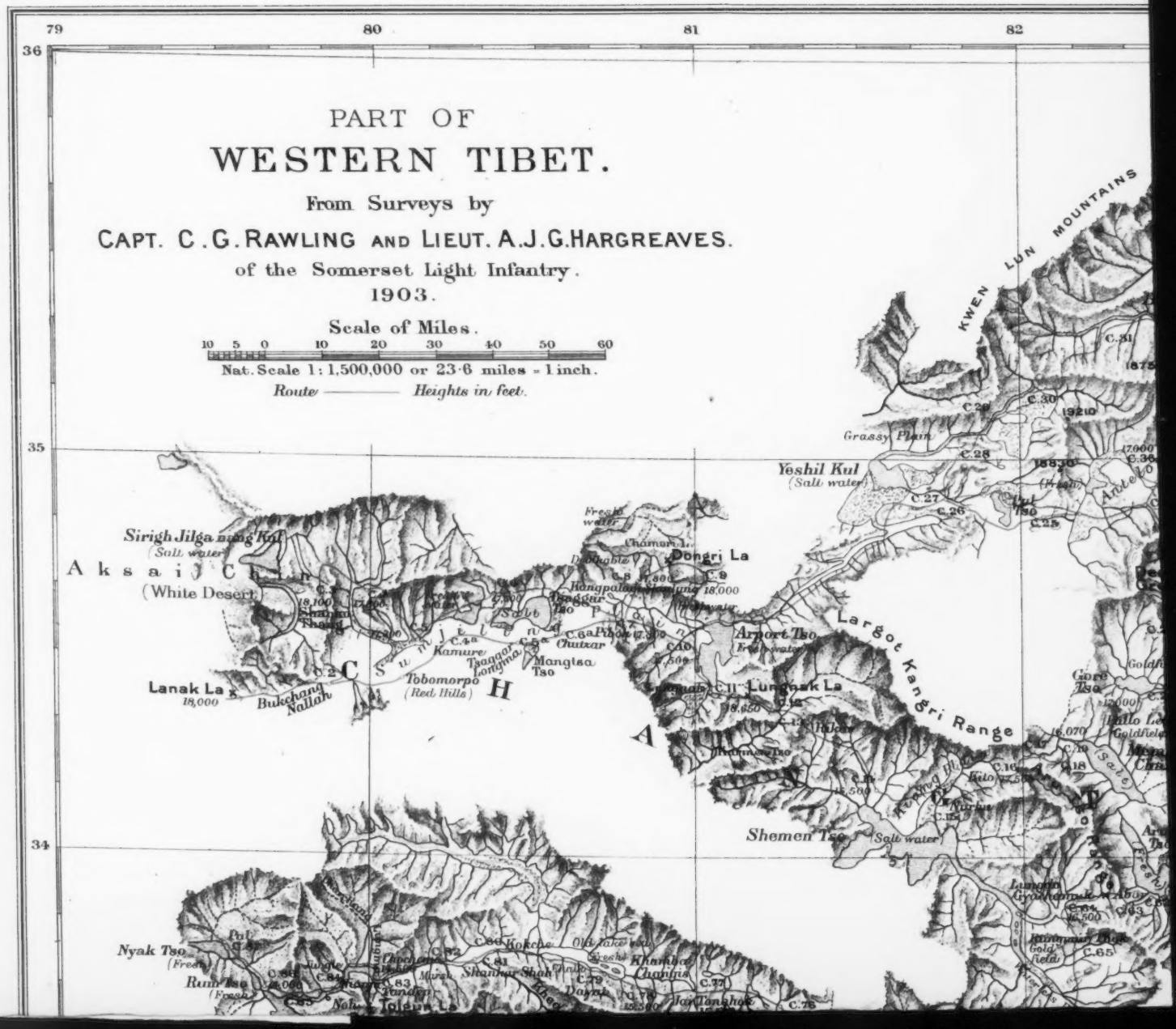
Tibet. **Landon.**

Twenty-four reproductions of photographs taken during the British Mission to Lhasa, by Percival Landon, Esq. *Presented by Percival Landon, Esq.*

These excellent photographic reproductions are the illustrations in Mr. Landon's recently published book 'Lhasa.' They are remarkably good specimens, and, as will be seen from the titles, the subjects are specially interesting—

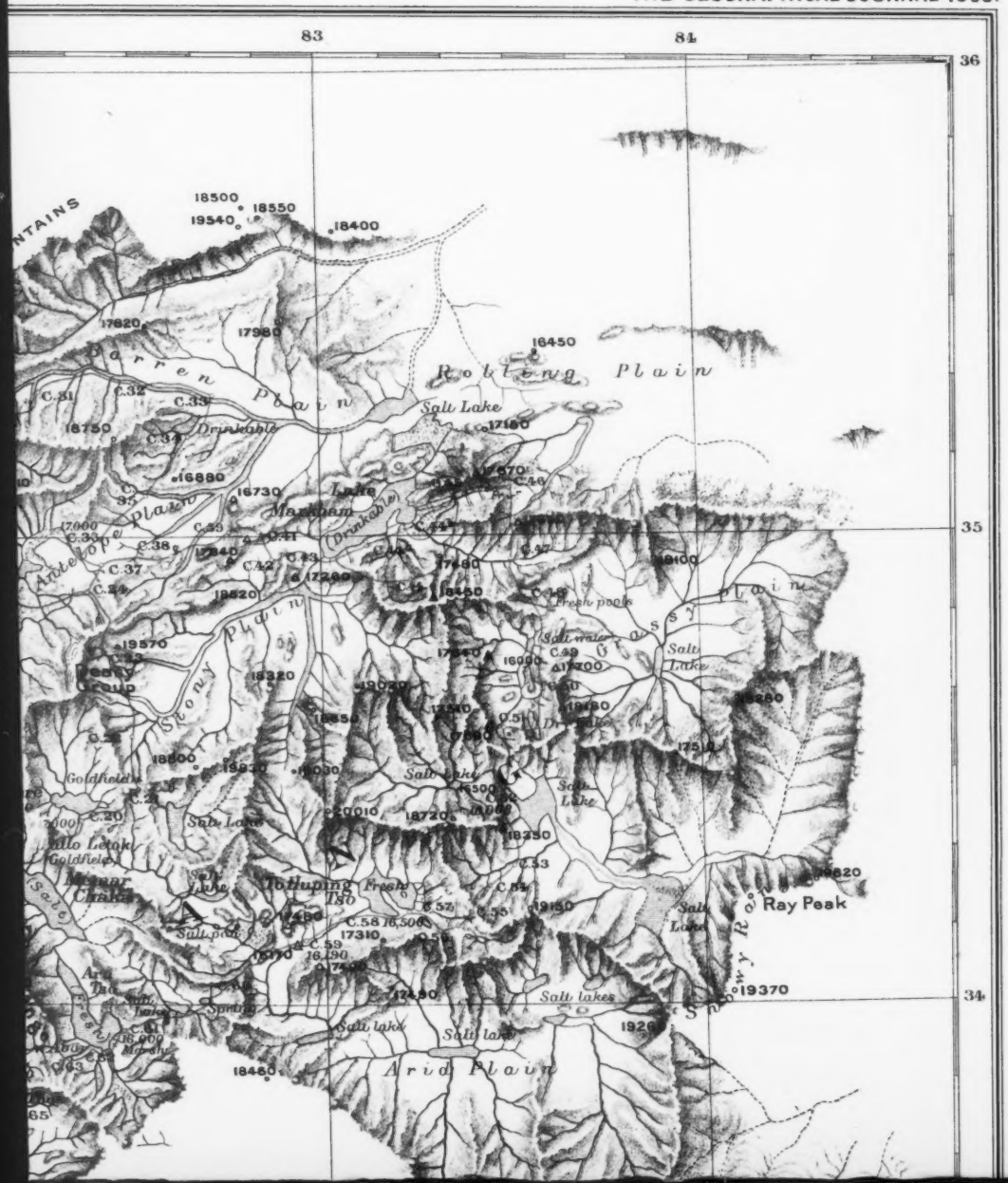
(1) Gautso, in the Chumbi valley; (2) Red Idol gorge; (3) Phari Jong; (4) On the glacis of Phari fort; (5) Convoy of yaks passing the Tang La in a blizzard; (6) The glacier lake at the Karo La; (7) Before sunrise on the Karo La; (8) Gobshi; (9) Gyantse Jong; (10) The iris wood at Gyantse; (11) The Tibetan wall at the Hot Springs; (12) A Tibetan sanctuary; (13) On the Rong Li; (14) Evening by the Kyi Chu; (15) Outside the western gate of Lhasa; (16) Pargo Kaling, the western gate of Lhasa; (17) The view inside the western gate of Lhasa; (18) The Potala Palace; (19) The entrance to the cathedral of Lhasa; (20) The chief magician's temple at Lhasa; (21) The throne of the chief magician, Lhasa; (22) Street scene in Lhasa; (23) In the Lukang gardens at Lhasa; (24) On the Ling-Kor, Lhasa.

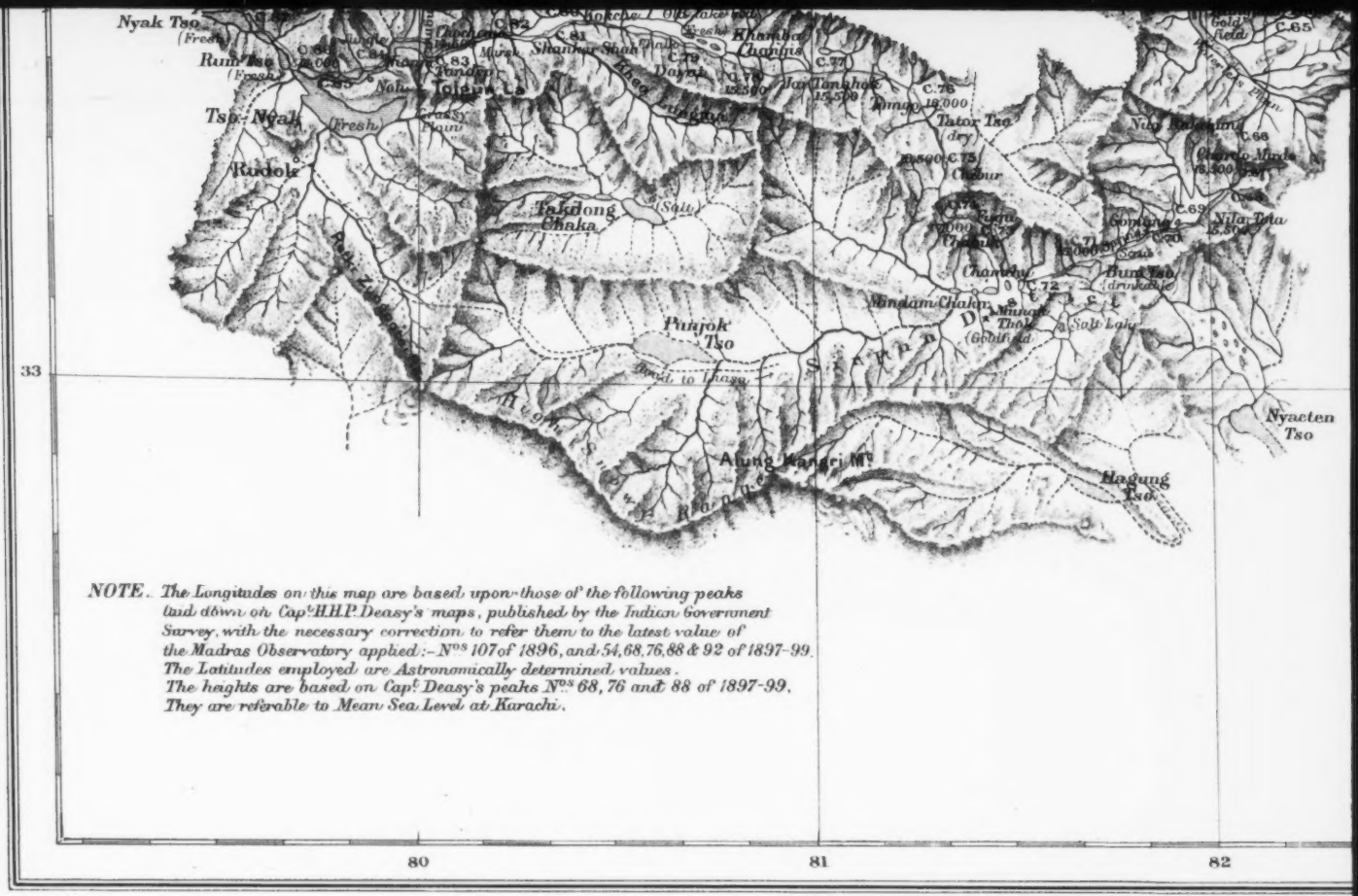
N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.


PART OF
WESTERN TIBET.
From Surveys by
CAPT. C. G. RAWLING AND LIEUT. A. J. G. HARGREAVES.
of the Somerset Light Infantry.
1903.
Scale of Miles.
10 5 0 10 20 30 40 50 60
Nat. Scale 1: 1,500,000 or 23·6 miles = 1 inch.
Route ——— Heights in feet.
79
80
81
82
36
35
34
KWEN LUN MOUNTAINS
Grassy Plain
Yeshil Kul
(Salt water)
Sirigh Jilga
Salt water
Aksai Chin
(White Desert)
Dongri La
Largot Kangri Range
Lanak La
18,000
Bukchang Nallah
Tobomorpo
(Red Hills)
Kamure
Tsangar
Mangtsa Tso
Chutxar
Arport Tso
Fresh water
Lungnak La
Shamur Tso
Shemen Tso
Salt water
Nyak Tso
Fresh
Rum Tso
Fresh
Kokche
Shankar Shah
Khamba Chantus
Dayak
Jai Tankhok
Toldum La
Gore Tso
Goldfields
Chamen La
Fresh water
Salt water
1920
18830
17000
18,000
16,070
16,500
15,580
15,650
18,100

WESTERN TIBET.

RAWLING & HARGREAVES.




Nyak Tso
(Fresh)
Rum Tso
(Fresh)
Tsomo Nyak
(Fresh)
Rudok
Takdong Chaka
(Salt)
Punjok Tso
Boundary to Thagu
Thagu Spur
Rokpo Pu
Shankar Shah
Khamba Chanus
Dayai
Jar Tankhak
15,570
Tator Tso
(dry)
Chabur
Yeh Tso
Nilar Tso
15,500
Thun Tso
(drinkable)
Gondan
Chanday
Mindam Chakar
Mindam Thok
(Gold field)
Salt Lake
Nyacten Tso
Hagung Tso
Gold Field
C.65
C.66
C.67
C.68
C.69
C.70
C.71
C.72
C.73
C.74
C.75
C.76
C.77
C.78
C.79
C.80
C.81
C.82
C.83
C.84
C.85
C.86
C.87
C.88
C.89
C.90
C.91
C.92
18,000
18,300
19,000
19,200
19,300
19,400
19,500
19,600
19,700
19,800
19,900
20,000
20,100
20,200
20,300
20,400
20,500
20,600
20,700
20,800
20,900
21,000
21,100
21,200
21,300
21,400
21,500
21,600
21,700
21,800
21,900
22,000
22,100
22,200
22,300
22,400
22,500
22,600
22,700
22,800
22,900
23,000
23,100

Snowy Range
Khotan
Kuria
Polu
Yarkand R.
Karakoram
Yeshil Kul
L. Markham
Prejevalsky Mts
KASHMIR
SRINAGAR
Leh
Pangong L.
Thukje
Indus R.
Chenab R.
Ravi R.
PUNJAB
LAHORE
R. Sutlej
Patiala
Merut
DELHI
RAJPUTANA
R. Jamna
R. Chambal
Gwalior
Lucknow
Allahabad
Patna
R. Ganges
Son R.
Jabalpur
Narbada R.
CENTRAL PROVINCES
Chota Nagpur
Orissa
Howrah
CALCUTTA
Ganges Delta
Dacca
ASSAM
Brahmaputra R.
BHUTAN
Darjiling
Sikkim
Mt. Everest
NEPAL
HIMALAYA MOUNTAINS
LUNGMO MOUNTAINS
CHINESE EMPIRE
TIBET
Dangla Mts
Gyaring Tso
Tangri Nor
Dangra Yum Tso
Gartok
Nyacten Tso
Tsang Po
Shigatse
LHASA
Yamdok Tso
Scale of Miles
Nat. Scale 1: 20,000,000 or 316 miles-1 inch